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SILVER PEAK RANGE NORTH G-E-M

RESOURCES AREA

(GRA NO. NV-19)

TECHNICAL REPORT

(WSA NV 050-0338)

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Final Report

April 29, 1983

TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY	1
I. INTRODUCTION	3
II. GEOLOGY	9
1. PHYSIOGRAPHY	9
2. ROCK UNITS	9
3. STRUCTURAL GEOLOGY AND TECTONICS	11
4. PALEONTOLOGY	12
5. HISTORICAL GEOLOGY	12
III. ENERGY AND MINERAL RESOURCES	14
A. METALLIC MINERAL RESOURCES	14
1. Known Mineral Deposits	14
2. Known Prospects, Mineral Occurrences and Mineralized Areas	14
3. Mining Claims	15
4. Mineral Deposit Types	16
5. Mineral Economics	16
B. NONMETALLIC MINERAL RESOURCES	18
1. Known Mineral Deposits	18
2. Known Prospects, Mineral Occurrences and Mineralized Areas	18
3. Mining Claims, Leases and Material Sites	18
4. Mineral Deposit Types	18
5. Mineral Economics	18

Table of Contents cont.

	Page
C. ENERGY RESOURCES	19
Uranium and Thorium Resources	19
1. Known Mineral Deposits	19
2. Known Prospects, Mineral Occurrences and Mineralized Areas	19
3. Mining Claims	21
4. Mineral Deposit Types	21
5. Mineral Economics	21
Oil and Gas Resources	22
Geothermal Resources	23
1. Known Geothermal Deposits	23
2. Known Prospects, Geothermal Occurrences, and Geothermal Areas	23
3. Geothermal Leases	24
4. Geothermal Deposit Types	24
5. Geothermal Economics	24
D. OTHER GEOLOGICAL RESOURCES	25
E. STRATEGIC AND CRITICAL MINERALS AND METALS	25
IV. LAND CLASSIFICATION FOR G-E-M RESOURCES POTENTIAL	26
1. LOCATABLE RESOURCES	27
a. Metallic Minerals	27
b. Uranium and Thorium	28
c. Nonmetallic Minerals	29

Table of Contents cont.

Page

2. LEASABLE RESOURCES 29

a. Oil and Gas 29

b. Geothermal 29

c. Sodium and Potassium 30

3. SALEABLE RESOURCES 30

V. RECOMMENDATIONS FOR ADDITIONAL WORK 31

VI. REFERENCES AND SELECTED BIBLIOGRAPHY 32

Table of Contents cont.

Page

LIST OF ILLUSTRATIONS

Figure 1 Index Map of Region 3 showing the Location of the GRA 5

Figure 2 Topographic map of GRA, scale 1:250,000 6

Figure 3 Geologic map of GRA, scale 1:250,000 7

CLAIM AND LEASE MAPS (Attached)

Patented/Unpatented

Oil and Gas

Geothermal

Sodium and Potassium

MINERAL OCCURRENCE AND LAND CLASSIFICATION MAPS (Attached)

Metallic Minerals

Uranium and Thorium

Nonmetallic Minerals

Oil and Gas

Geothermal

Level of Confidence Scheme

Classification Scheme

Major Stratigraphic and Time Divisions in Use by the U. S. Geological Survey

EXECUTIVE SUMMARY

The Silver Peak Range North Geology-Energy-Minerals (GEM) Resource Area (GRA) is ten miles west of Silver Peak, in Esmeralda County, Nevada. It covers much of the Silver Peak Range. There is one Wilderness Study Area (WSA): NV 050-0338.

Around the edges of the GRA are exposed sedimentary rocks about 500 million years old that were intruded by granitic bodies about 150 million years ago. The Mineral Ridge and Dyer districts in the GRA were formed by these old intrusions and the old rocks underlie the entire GRA at unknown depth. In most of the GRA are exposed volcanic rocks that were built up around a group of volcanoes in the center of the GRA about 6 million years ago. Near the end of the period of volcanism the roof of the chamber of molten rock that fed the volcanoes collapsed to form what is called a caldera: a large block of ground that has sunk perhaps a thousand feet or more below the surrounding country. The Silver Peak caldera is about four miles wide and eight miles long, and was essentially filled with lava in the last eruptions of the volcanoes. Fluids released after volcanism ceased deposited the silver-bearing quartz veins of the Red Mountain district, and there are geological indications that similar mineralization is very close to the WSA or possibly within it.

There are three mining districts in the GRA: the highly productive old Mineral Ridge gold district in the northeast corner, the Red Mountain silver district in which a substantial silver mine is now operating, and the Dyer district at the west end of the WSA which has produced a little silver and base metals. Some boron has been produced from the northwest corner of the GRA.

There are some patented claims, mostly in the Mineral Ridge district and none close to the WSA. There are a great many unpatented claims in all three districts and in the boron-bearing area, and a few claims lie within the WSA. There are a few scattered oil and gas leases. There are numerous geothermal leases in the area, some of which are in the GRA.

The western and central part of the WSA is classified as moderately favorable for base metals or tungsten (a strategic and critical metal) in the older rocks that are mostly covered by young lava flows and other volcanic rocks. The level of confidence for this classification is low. The eastern part of the WSA is classified as having low favorability for precious metal resources around a center of old volcanic eruptions that lies partly within the WSA. Again, the level of confidence for this classification is low. The remainder of the WSA is classified as having low favorability for metallic mineral resources of either of the above nature, with very low confidence. The entire WSA is classified as having low favorability for uranium and thorium resources, with low confidence. The entire WSA is classified as having low favorability for nonmetallic

mineral resources, with a low level of confidence. There is a high level of confidence for very low favorability for oil and gas. The favorability for geothermal resources is moderate with a low level of confidence.

Field work is recommended to check three areas in which metallic mineralization may be present in WSA NV 050-0338.

I. INTRODUCTION

The Silver Peak Range North G-E-M Resources Area (GRA No. NV-19) contains approximately 170,000 acres (680 sq km) and includes the following Wilderness Study Area (WSA):

WSA Name	WSA Number
Silver Peak Range North	NV 050-0338

The GRA is located in Nevada in the Bureau of Land Management's (BLM) Stateline/Esmeralda Resource Area, Las Vegas district. Figure 1 is an index map showing the location of the GRA. The area encompassed is near 37°45' north latitude, 117°46' west longitude and includes the following townships:

T 1 S, R 36-38 E
T 2 S, R 35-38 E
T 3 S, R 36-38 E

The areas of the WSA are on the following U. S. Geological Survey topographic maps:

15-minute:

Rhyolite Ridge
Mt. Barcroft
Piper Peak

The nearest town is Dyer which is located about four miles west of the western GRA boundary on State Route 3A. Access to the area is via State Route 3A to the west and State Route 47 to the east. Access within the area is via unimproved light duty and dirt roads scattered throughout the GRA.

Figure 2 outlines the boundaries of the GRA and the WSA on a topographic base at a scale of 1:250,000.

Figure 3 is a geologic map of the GRA and vicinity, also at 1:250,000. At the end of the report, following the Land Classification Maps, is a geologic time scale showing the various geologic eras, periods and epochs by name as they are used in the text, with the corresponding age in years. This is so that the reader who is not familiar with geologic time subdivisions will have a comprehensive reference for the geochronology of events.

This GRA Report is one of fifty-five reports on the Geology-Energy-Minerals potential of Wilderness Study Areas in the Basin

and Range province, prepared for the Bureau of Land Management by the Great Basin GEM Joint Venture.

The principals of the Venture are Arthur Baker III, G. Martin Booth III, and Dennis P. Bryan. The study is principally a literature search supplemented by information provided by claim owners, other individuals with knowledge of some areas, and both specific and general experience of the authors. Brief field verification work was conducted on approximately 25 percent of the WSAs covered by the study.

The WSA in this GRA was not field checked.

One original copy of background data specifically applicable to this GEM Resource Area Report has been provided to the BLM as the GRA File. In the GRA File are items such as letters from or notes on telephone conversations with claim owners in the GRA or the WSA, plots of areas of Land Classification for Mineral Resources on maps at larger scale than those that accompany this report if such were made, original compilations of mining claim distribution, any copies of journal articles or other documents that were acquired during the research, and other notes as are deemed applicable by the authors.

As part of the contract that resulted in this report, a background document was also written: Geological Environmets of Energy and Mineral Resources. A copy of this document is included in the GRA File to this GRA report. There are some geological environments that are known to be favorable for certain kinds of mineral deposits, while other environments are known to be much less favorable. In many instances conclusions as to the favorability of areas for the accumulation of mineral resources, drawn in these GRA Reports, have been influenced by the geology of the areas, regardless of whether occurrences of valuable minerals are known to be present. This document is provided to give the reader some understanding of at least the most important aspects of geological environments that were in the minds of the authors when they wrote these reports.

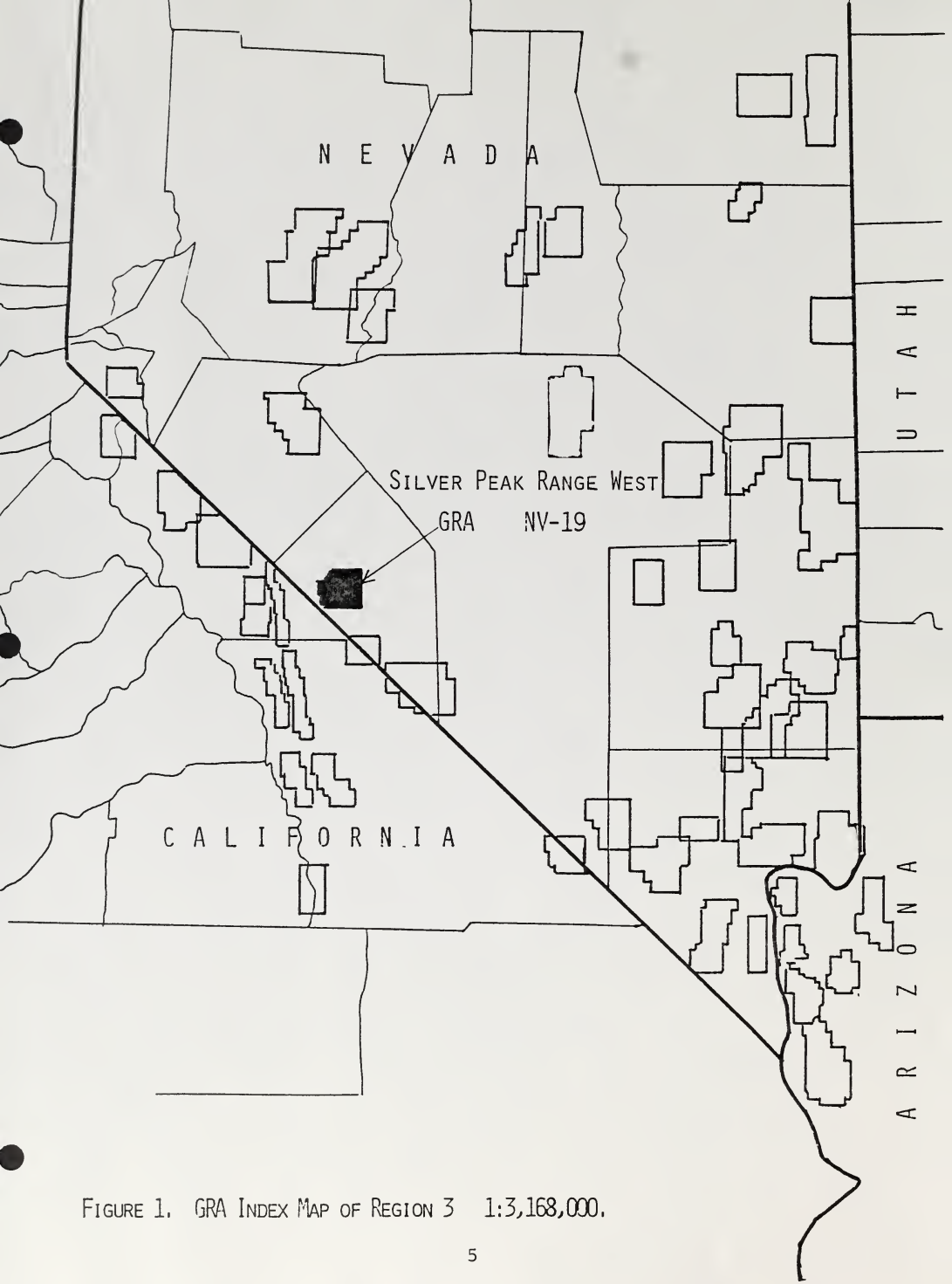
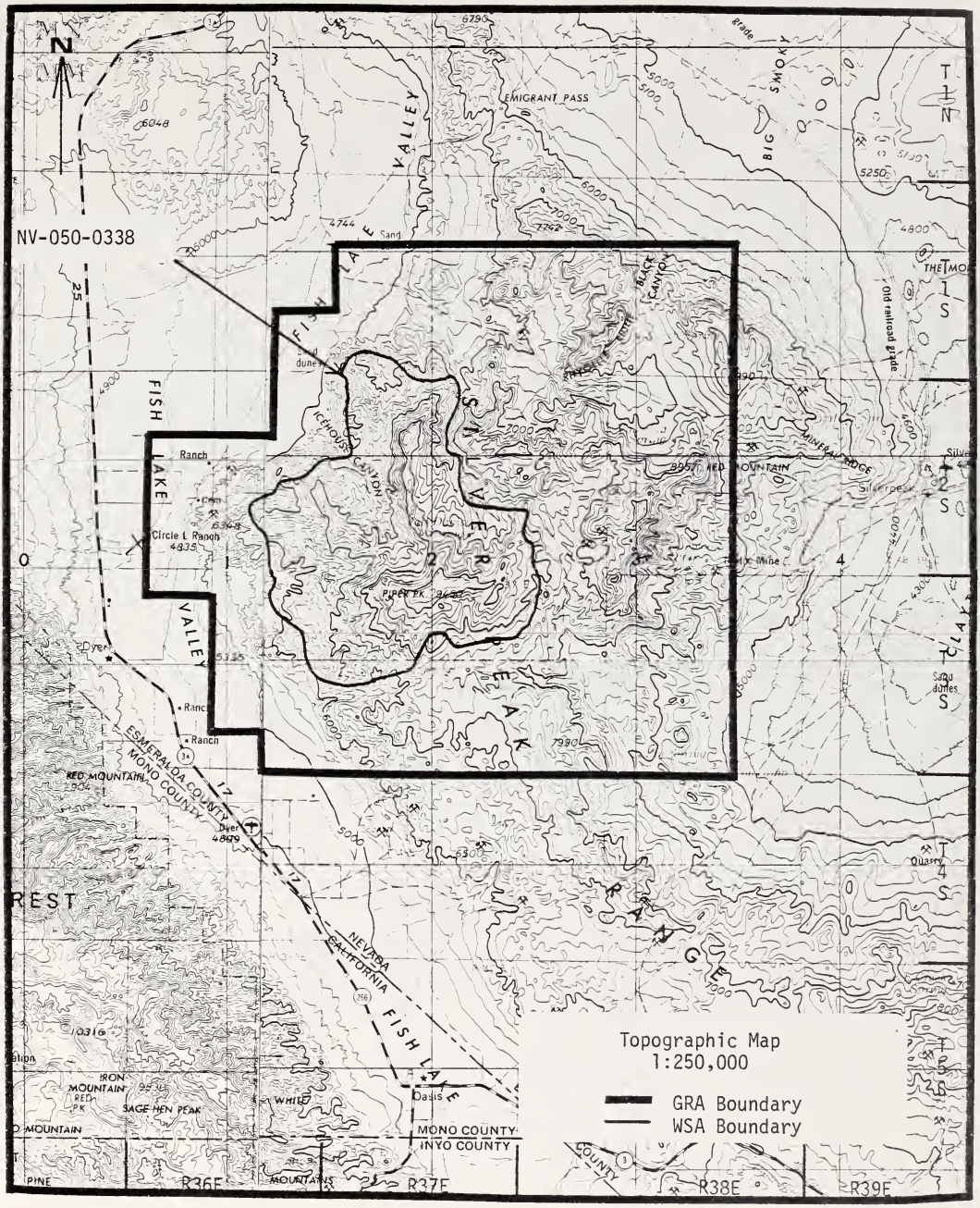


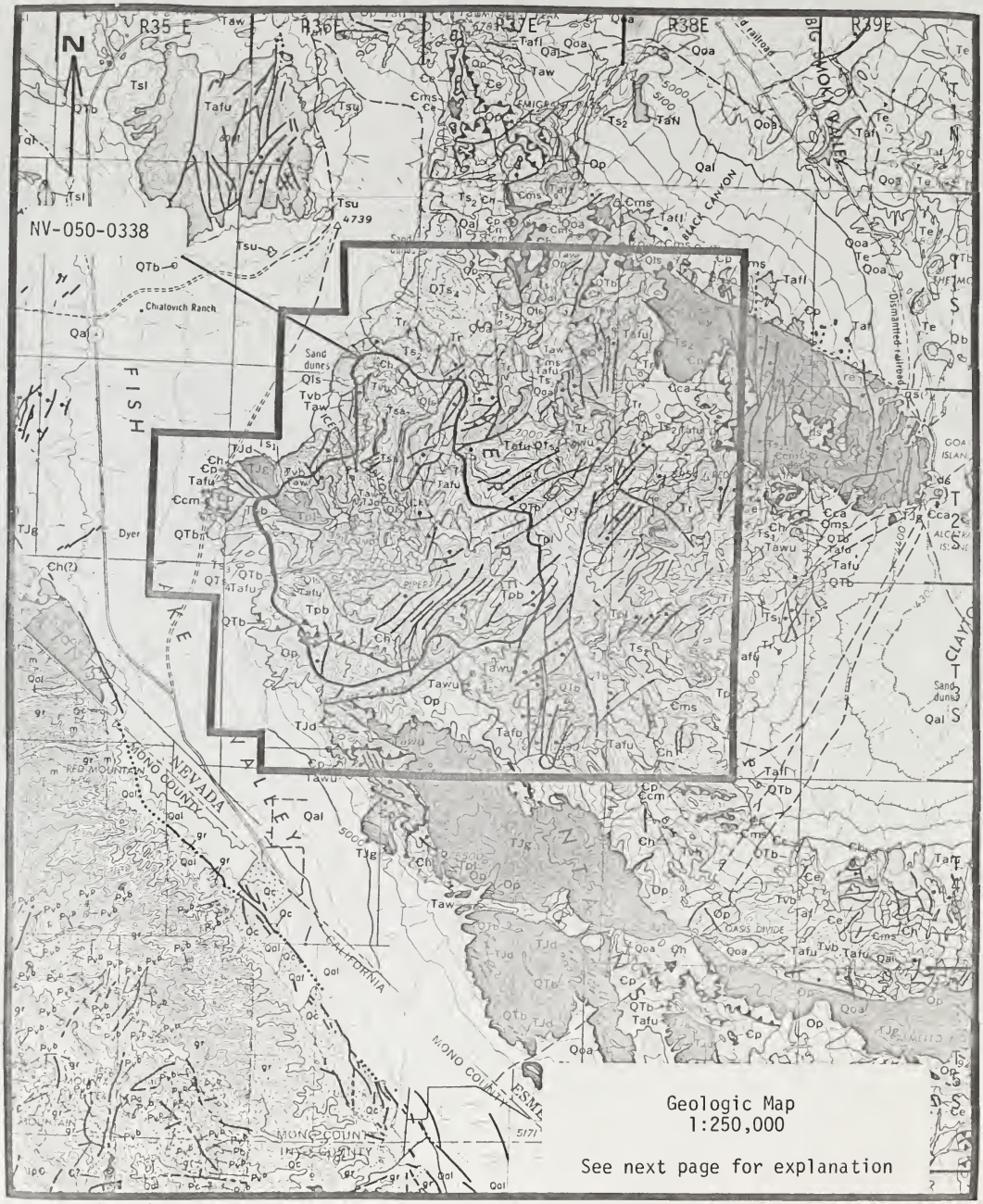
FIGURE 1. GRA INDEX MAP OF REGION 3 1:3,168,000.



Goldfield and Mariposa Sheets

Silver Peak Range North GRA NV-19

Figure 2



Strand (1967);
Albers and Stewart (1972)

Silver Peak Range North GRA NV-19

Figure 3

EXPLANATION

SEDIMENTARY AND METASEDIMENTARY ROCKS

CENOZOIC

QUATERNARY

Recent

- Qs — Dune sand
- Qal — Alluvium
- GREAT VALLEY
  - Qsc — Stream channel deposits
  - Qf — Fan deposits
  - Qb — Basin deposits
- Qst — Salt deposits
- Ql — Quaternary lake deposits
- Qg — Glacial deposits

Pleistocene

- Qt — Quaternary nonmarine terrace deposits
- Qm — Pleistocene marine and marine terrace deposits
- Qc — Pleistocene nonmarine
- QP — Plio-Pleistocene nonmarine

TERTIARY

Pliocene

- Pc — Undivided Pliocene nonmarine
- Puc — Upper Pliocene nonmarine
- Pu — Upper Pliocene marine
- Pmic — Middle and/or lower Pliocene nonmarine
- Pml — Middle and/or lower Pliocene marine

Miocene

- Mc — Undivided Miocene nonmarine
- Muc — Upper Miocene nonmarine
- Mu — Upper Miocene marine
- Mmc — Middle Miocene nonmarine
- Mm — Middle Miocene marine
- Ml — Lower Miocene marine

Oligocene

- Φc — Oligocene nonmarine
- Φ — Oligocene marine

Eocene

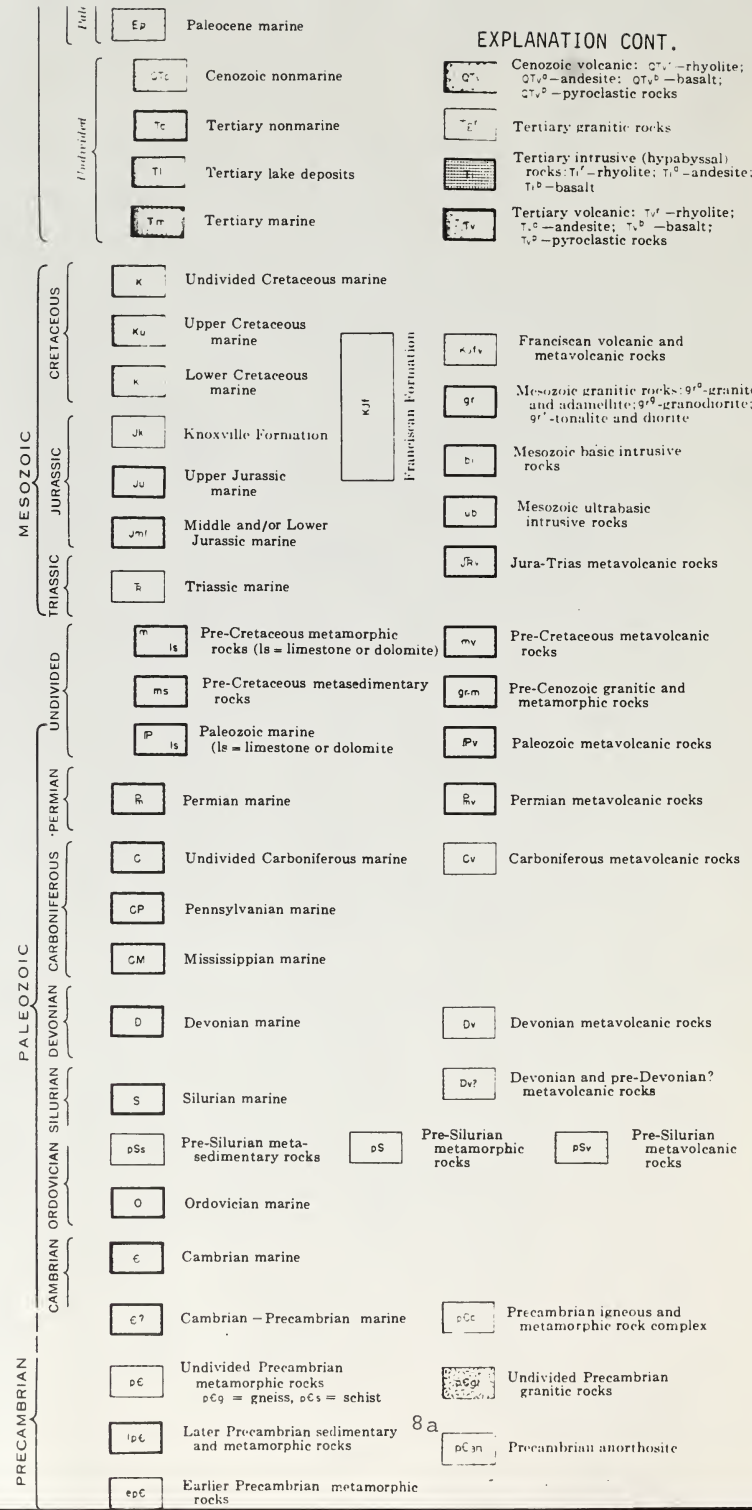
- Ec — Eocene nonmarine
- E — Eocene marine

Paleocene

- Epc — Paleocene nonmarine
- Ep — Paleocene marine

IGNEOUS AND META-IGNEOUS ROCKS

- Recent volcanic: Q_{rv}^{r} —rhyolite; Q_{rv}^{a} —andesite; Q_{rv}^{b} —basalt; Q_{rv}^{p} —pyroclastic rocks
- Pleistocene volcanic: Q_{pv}^{r} —rhyolite; Q_{pv}^{a} —andesite; Q_{pv}^{b} —basalt; Q_{pv}^{p} —pyroclastic rocks
- Quaternary and/or Pliocene cinder cones
- Pliocene volcanic: P_{v}^{r} —rhyolite; P_{v}^{a} —andesite; P_{v}^{b} —basalt; P_{v}^{p} —pyroclastic rocks
- Miocene volcanic: M_{v}^{r} —rhyolite; M_{v}^{a} —andesite; M_{v}^{b} —basalt; M_{v}^{p} —pyroclastic rocks
- Oligocene volcanic: Φ_{v}^{r} —rhyolite; Φ_{v}^{a} —andesite; Φ_{v}^{b} —basalt; Φ_{v}^{p} —pyroclastic rocks
- Eocene volcanic: E_{v}^{r} —rhyolite; E_{v}^{a} —andesite; E_{v}^{b} —basalt; E_{v}^{p} —pyroclastic rocks


EXPLANATION CONT.
Paleocene marine
Cenozoic nonmarine
Tertiary nonmarine
Tertiary lake deposits
Tertiary marine
Undivided Cretaceous marine
Upper Cretaceous marine
Lower Cretaceous marine
Knoxville Formation
Upper Jurassic marine
Middle and/or Lower Jurassic marine
Triassic marine
Pre-Cretaceous metamorphic rocks (ls = limestone or dolomite)
Pre-Cretaceous metasedimentary rocks
Paleozoic marine (ls = limestone or dolomite
Permian marine
Undivided Carboniferous marine
Pennsylvanian marine
Mississippian marine
Devonian marine
Silurian marine
Pre-Silurian meta-sedimentary rocks
Ordovician marine
Cambrian marine
Cambrian – Precambrian marine
Undivided Precambrian metamorphic rocks
Later Precambrian sedimentary and metamorphic rocks
Earlier Precambrian metamorphic rocks
Franciscan Formation
Cenozoic volcanic
Tertiary granitic rocks
Tertiary intrusive (hypabyssal) rocks
Tertiary volcanic
Franciscan volcanic and metavolcanic rocks
Mesozoic granitic rocks
Mesozoic basic intrusive rocks
Mesozoic ultrabasic intrusive rocks
Jura-Trias metavolcanic rocks
Pre-Cretaceous metavolcanic rocks
Pre-Cenozoic granitic and metamorphic rocks
Paleozoic metavolcanic rocks
Permian metavolcanic rocks
Carboniferous metavolcanic rocks
Devonian metavolcanic rocks
Devonian and pre-Devonian? metavolcanic rocks
Pre-Silurian metamorphic rocks
Pre-Silurian metavolcanic rocks
Precambrian igneous and metamorphic rock complex
Undivided Precambrian granitic rocks
Precambrian anorthosite
MESOZOIC
PALEOZOIC
PRECAMBRIAN
CRETACEOUS
JURASSIC
TRIASSIC
PERMIAN
CARBONIFEROUS
DEVONIAN
SILURIAN
ORDOVICIAN
CAMBRIAN
UNDIVIDED

8a

EXPLANATION

Holocene

Qal — Desert wash, colluvium, alluvium, and playa deposits

Qp — Playa lake deposits

Pleistocene or Holocene

WHITE MOUNTAINS, VOLCANIC HILLS, NORTH END OF FISH LAKE VALLEY, MILLER MOUNTAIN, AND CANDELARIA HILLS

Ql — Landslide deposits

Qoa — Older alluvium (Chiefly gravel)

Qm — Glacial moraine

SILVER PEAK AND PALMETTO MOUNTAINS

Ql — Landslide deposits

Qoa — Older alluvium

WEEPAH HILLS, LONE MOUNTAIN, ANGEL ISLAND AND NORTHEASTERN PART OF CLAYTON VALLEY

Qb — Basalt

Qoa — Older alluvium (Chiefly gravel)

MONTE CRISTO RANGE AND CEDAR MOUNTAINS

Qoa — Older alluvium (Chiefly gravel)

TONOPAH AREA

Qoa — Older alluvium (Chiefly gravel)

GOLDFIELD HILLS, MONTEZUMA RANGE, CLAYTON RIDGE, AND MOUNT JACKSON RIDGE

Ql — Landslide deposits

Qs — Bedded clay and silt

SLATE RIDGE, AND END OF CO

Pliocene or Pleistocene

WHITE MOUNTAINS, VOLCANIC HILLS, NORTH END OF FISH LAKE VALLEY, MILLER MOUNTAIN, AND CANDELARIA HILLS

QTb — Basalt

QTd — Diatomite

QTs — Weakly lithified sandstone and conglomerate

SILVER PEAK AND PALMETTO MOUNTAINS

QTs — Sedimentary unit 4 — Weakly lithified conglomerate and tuffaceous rock

QTb — Basalt — Age 4.0 m.y. (million years) by K-Ar methods (Robinson and others, 1968, table 1, no. 7)

WEEPAH HILLS, LONE MOUNTAIN, ANGEL ISLAND AND NORTHEASTERN PART OF CLAYTON VALLEY

QTb — Basalt

MONTE CRISTO RANGE AND CEDAR MOUNTAINS

QTb — Basalt

TONOPAH AREA

QTb — Basalt — Olivine basalt

GOLDFIELD HILLS, MONTEZUMA RANGE, CLAYTON RIDGE, AND MOUNT JACKSON RIDGE

QTb, QTmr — Malpais Basalt and Rabbit Spring Formation

QTb, basalt; QTmr, Malpais Basalt and Rabbit Spring Formation

SLATE RIDGE, AND END OF CO

QTb — Basalt

QTg — Weakly consolidated g… and sand

Miocene

WHITE MOUNTAINS, VOLCANIC HILLS, NORTH END OF FISH LAKE VALLEY, MILLER MOUNTAIN, AND CANDELARIA HILLS

Tsu — Upper sedimentary unit — Shale, siltstone, sandstone, limestone, and conglomerate

Tr — Rhyolite plug or flow

Tpl, Ts — Porphyritic latite or trachyandesite — Tpl, porphyritic latite, K-Ar age is 5.9 m.y. (Robinson and others, 1968, no. 5); Ts, sedimentary rocks, sandstone conglomerate, and tuff

Tuff — Upper nonwelded ash flow unit

Tq — Quartz latite

Tpa — Rhyolitic airfall tuff — Includes some rhyolitic lava flows and partially ecast nonwelded ash flows; K-Ar age 8.0 m.y. (Robinson and others, 1968, table 1, no. 6)

Tsu — Lower sedimentary unit — Mainly tuffaceous sedimentary rocks. Previously referred to as the Esmeralda Formation

Tp — Porphyrite andesite

Tvb — Volcanic breccia of andesitic or dacitic composition

SILVER PEAK AND PALMETTO MOUNTAINS

Tpl, Ts — Porphyritic latite or trachyandesite — Tpl, porphyritic latite, K-Ar age is 5.9 m.y. (Robinson and others, 1968, no. 5); Ts, sedimentary rocks, sandstone conglomerate, and tuff

Ta — Andesite — Probably in part intrusive

Tpa — Rhyolitic airfall tuff — Includes some rhyolite lava flows and partially ecast nonwelded ash flows; K-Ar age 8.0 m.y. (Robinson and others, 1968, table 1, no. 6)

Tr — Rhyolitic flows, domes, breccias, and intrusive masses

Ts2 — Sedimentary unit 2 and welded ash flow — Ts2, Tuffaceous shale and sandstone. Age 12.7 m.y. by K-Ar method (Ekren and Dorr, 1966); Tsa2, Welded ash flow

Tvb — Volcanic breccia — Andesitic and dacitic (?) in composition

Ts1 — Sedimentary unit 1

Tpb — Porphyritic basalt

Tb — Basalt — Age 8.1 m.y. by K-Ar method (Robinson and others, 1968, table 1, no. 3)

Tub — Upper welded ash flow

WEEPAH HILLS, LONE MOUNTAIN, ANGEL ISLAND AND NORTHEASTERN PART OF CLAYTON VALLEY

Tr — Rhyolite plug or flow

Ts, Ta, Tb — Esmeralda Formation and ash-flow deposits — Ts, Shale, siltstone, sandstone, and tuff in Esmeralda Formation, shale, sandstone, and tuff. Includes some beds as young as 8.9 m.y. (Robinson and others, 1968, table 1, no. 13); Tat, ash flow tuff

Tsw — Welded ash flow

Tsw — Rhyolitic to quartz latitic welded ash flows

Tnw — Nonwelded ash flow

MONTE CRISTO RANGE AND CEDAR MOUNTAINS

Tg — Gilbert Andesite — An apparent unconformity. A K-Ar date of 13.1 m.y. was obtained from the Gilbert Andesite (table 3, this report)

Tr — Rhyolite plugs, domes, and flows

Ts — Shale, siltstone, sandstone, limestone, and tuff — Formerly referred to as Esmeralda Formation. Correlative rocks a few miles north of Esmeralda County are 10.7 and 11.5 m.y. old by K-Ar method (Ekren and others, 1968, p. 177, 180)

Taf — Quartz latite and felsite — Includes Bronopah Dacite. Age 18.2 m.y. by K-Ar method (table 3, this report)

Ta — Andesite — Includes Davade Andesite

To — Oddie(?) Rhyolite

Ts — Siebert Tuff — Tuff, tuffaceous shale and dolomite, locally includes some sandstone and conglomerate

Tab — Rhyolite breccia — Locally greater than welded ash flows; includes lower part of Esmeralda Formation of Ferguson and others (1953)

Tfb — Fraction Breccia — Ash flows of dominantly ahydrite composition. Correlated with rocks in Nye County which are dated at 17.5 m.y. by K-Ar method

Tnf — Welded and nonwelded ash flows

TONOPAH AREA

Taf — Quartz latite and felsite — Includes Bronopah Dacite. Age 18.2 m.y. by K-Ar method (table 3, this report)

Ta — Andesite — Includes Davade Andesite

To — Oddie(?) Rhyolite

Ts — Siebert Tuff — Tuff, tuffaceous shale and dolomite, locally includes some sandstone and conglomerate

Tnf — Welded and nonwelded ash flows

GOLDFIELD HILLS, MONTEZUMA RANGE, CLAYTON RIDGE, AND MOUNT JACKSON RIDGE

Tmr — Thirsty Canyon Tuff — Spearhead Member in Nye County has K-Ar age of 7.3 m.y. (Noble and others, 1964, p. D13)

Tpz — Pozo Formation — Dominantly conglomerate and subordinate sandstone, poorly consolidated

Tr — Dark rhyolite or rhyolacite — Dominantly aquinoinals

Tcs — Conglomerate and sandstone — Possibly correlative with Pozo Formation

Tr — Rhyolite plugs, domes, and flows

Tpl — Porphyritic latite or trachyandesite

Tsw — Welded ash flows

Tnw — Lower nonwelded ash flow — Age 11.4 m.y. by K-Ar method (Robinson and others, 1968, table 1, no. 11)

Tnf — Lower nonwelded ash flow — May include some airfall tuff

SLATE RIDGE, AND END OF CO

Tmr — Thirsty Canyon Tuff — In map area intruder only. Spearhead and Trail Ridge Members. Spearhead Member in Nye County has K-Ar age of 7.3 m.y. (Noble and others, 1964, p. D13)

Tpz — Ammonia Tanks Member of T… Mountain Tuff — Welded ash flows. Ammonia Tanks Nye County is 10.3 to 11.3 m.y. … methods (R. W. Kistler, written com… 1965)

Tnf — Airfall tuff and nonwelded as… — May include lower part of Ammon… Member of Timber Mountain …

Miocene

SILVER PEAK AND PALMETTO MOUNTAINS

Tsw — Welded ash flows — Age 12.8 m.y. by K-Ar method (Robinson and others, 1968, table 1, no. 14)

Tnf — Lower nonwelded ash flow — May include some airfall tuff

Tsw — Lower welded ash flow — Age 21.3 m.y. by K-Ar method (Robinson and others, 1968, table 1, no. 12)

Tnf — Lower nonwelded ash flow

TONOPAH AREA

Tsw — Welded ash flows — Includes Arcdo Ignimbrite and dacite vitrophyre of Ransome (1909) — Age 12.1 m.y. by K-Ar method (this report, table 3)

To — Dacite — Age 20.8 to 21.6 m.y. by K-Ar method (this report, table 3)

Tm — Mizztown Andesite — Age 21.3 m.y. by K-Ar method (this report, table 3)

GOLDFIELD HILLS, MONTEZUMA RANGE, CLAYTON RIDGE, AND MOUNT JACKSON RIDGE

Tsi, Ts — Siebert Tuff and Mira Basalt — Ts, Siebert Tuff, dominantly tuffaceous sedimentary rocks of lacustrine origin; Tmi, Mira Basalt; flow intertongues with Siebert Tuff

Tat — Airfall tuff and tuffaceous shale — Airfall tuff and tuff breccia of rhyolitic composition

Tss — Tuffaceous shale and intertonguing airfall tuff

Ta — Andesite

Tc — Chispa Andesite

Tsw — Welded ash flows — Includes Arcdo Ignimbrite and dacite vitrophyre of Ransome (1909) — Age 12.1 m.y. by K-Ar method (this report, table 3)

To — Dacite — Age 20.8 to 21.6 m.y. by K-Ar method (this report, table 3)

Tm — Mizztown Andesite — Age 21.3 m.y. by K-Ar method (this report, table 3)

Oligocene or Miocene

Tss — Sandstorm Formation

TK — Kendall Tuff and latite of Ransome (1909a)

Tv — Vindicator Rhyolite — Includes Morey Rhyolite of Ransome (1909)

PRE-TERTIARY SEQUENCE APPLIES TO ENTIRE COUNTY EXCEPT MILLER MOUNTAIN AND GRAPEVINE MOUNTAINS AS NOTED BELOW

UNCONFORMITY

Ja, Tv — Dark aphanitic to medium-grained rocks of dioritic to andesitic composition

Tf, Tv — Felsic aphanitic rhyolite and quartz porphyry dike rocks

JTg — Coarse-grained granitic rocks — Mainly biotite quartz monzonite but includes some granodiorite and monzonite. Also includes pegmatitic material in Mineral Ridge area

JTr — Dunlap Formation — Red sandstone containing lenses of conglomerate and red shale

UNCONFORMITY

Tr — Excelsior Formation

UNCONFORMITY

Tv — Candelaria Formation — Shale and sandstone

UNCONFORMITY

Pd — Diablo Formation — Dolomite, grit, and conglomerate

JURASSIC TO TERTIARY

Lower and Middle Jurassic — JURASSIC

Middle Triassic(?) — TRIASSIC(?)

Lower Triassic — TRIASSIC

PERMIAN

MILLER MOUNTAIN AREA

Csh — Siliceous hornfels

Cm — Marble — Possibly correlative with Mule Spring Limestone

Cha — Harkless(?) Formation

Cp — Poleta(?) Formation — Siliceous and calc-silicate hornfels interbedded with marble

Cc — Campito Formation — Metamorphosed siltstone and quartzite

Upper Cambrian; Middle and Upper Cambrian; Middle(?) and Lower Cambrian; Lower Cambrian

UNCONFORMITY

Op — Palmetto Formation — Dominantly black shale; locally contains abundant chert, limestone, and quartzite

Ce — Emigrant Formation — Mostly sluggtone in lower part, overlain by thin-bedded limestone with cherty layers

Cm — Mule Spring Limestone

Ch — Harkless Formation — Dominantly green siltstone, locally includes strata lithologically similar to and correlative with Silene Valley Formation as defined by Nelson (1961)

Cp — Poleta Formation — Mostly thick-bedded carbonate in lower part, overlain by green siltstone with limestone and quartzite interbeds

Ccm, Ccs — Campito Formation — Ccm, Montenegro Member, dominantly green siltstone; Ccs, Andrews Mountain Member, dominantly dark-gray fine-ground quartzite

Ds — Deep Spring Formation — Dominantly well-bedded limestone and dolomite, subordinate dark quartzite

Rd — Reed Dolomite

Wy — Wyman Formation — Dominantly siltstone containing thin limestone interbeds

GRAPEVINE MOUNTAINS

Ms — Shaly rocks — Contains impure carbonate lenses with Mississippian fossils

FAULT

Op — Pogonip Group — Thick-bedded limestone with shaly interbeds

UNCONFORMITY(?)

Ce — Nopah Formation — Gray thick-bedded dolomite

MISSISSIPPIAN; ORDOVICIAN; CAMBRIAN; PRECAMBRIAN

Contact

High-angle fault — Dashed where approximately located, dotted where concealed. Bar and ball on downthrown side. Queried where doubtful

Low-angle fault or thrust — Dotted where concealed. Sawteeth on upper plate

Anticline — Showing crestline

Syncline — Showing trough line

Note: The Esmeralda Formation is herein restricted to include only the predominantly sedimentary upper unit as mapped by Ferguson and others (1953), and to exclude the Fraction Breccia from its lower part. The Spearhead was reduced in rank to a member of the Thirsty Canyon Tuff by Noble and others (1964)

GIC MAP OF ESMERALDA COUNTY, NEVADA

By

John P. Albers and John H. Stewart

SCALE 1 250 000

5 0 5 10 15 20 MILES

5 0 5 10 15 20 KILOMETERS

CONTOUR INTERVALS 100 AND 200 FEET

DATUM IS MEAN SEA LEVEL

II. GEOLOGY

Pre-Tertiary rocks are exposed in the Silver Peak GRA only near the northern and southern edges, except for a few small exposures near the west edge. Most of this part of the Silver Peak Range is a volcanic pile built in Pliocene time around a vent area in the center of the range. The site of the vent is marked by a caldera filled by late eruptions around the edges of the caldera.

There are three mining districts in the GRA, two of which are in pre-Tertiary rocks and are related to Triassic/Jurassic intrusions, while the third is in the volcanic pile and is related to the volcanism.

1. PHYSIOGRAPHY

The Silver Peak Range North GRA covers the central part of the Silver Peak mountains and extends to the edge of Fish Lake Valley on the west and Clayton valley on the east. The range continues north and south of the GRA.

The range is very rugged, with many narrow, steep-walled canyons and sharp ridges, but in places there are broad rolling highlands. The highest point, Piper Peak at 9,450 feet elevation, is on one of these. Much of the higher ground, roughly above elevation 7,000, is wooded with pinon pines, but lower elevations have the usual sagebrush desert growth. The valleys on either side of the range are at elevations of about 5,000 feet.

There are no permanent streams. The intermittent streams for the most part radiate from the vicinity of Piper Peak and eventually drain into either Fish Lake Valley or Clayton Valley, both of which are internal valleys with elevations about 4,500 feet and have no drainage exits.

2. ROCK UNITS

The part of the Silver Peak Range included in the GRA is largely underlain by Tertiary volcanic rocks, with Paleozoic rocks and Mesozoic intrusive bodies cropping out at the north and south edges of the GRA and in small areas at the west edge of the range. The Paleozoic rocks are part of a thick sequence, deposition of which began in Late Precambrian. Ten formations are distinguished, but only those formations that have bearing on the GRA will be described here. The central part of the range was a volcanic center during Late Tertiary, so the Tertiary rocks are thick and more than a dozen units have been distinguished, many of them with very local distribution. In the descriptions below, the Tertiary units are generalized.

Albers and Stewart (1972) present a 1:250,000 scale geologic map and detailed descriptions of the pre-Tertiary rocks, while Robinson and others (1976) and Stewart and others (1974) provide geologic maps at 1:62,500 for most of the GRA. The rock descriptions and structural patterns below are taken mostly from these sources. Geologic mapping of the west edge of the GRA and the western tip of WSA NV 050-0388 is provided by Krauskopf (1971) and Robinson and Crowder (1973).

The oldest rock exposed in the GRA is the Precambrian/Cambrian Campito Formation, 2,500 feet thick with massive quartzite in the lower part and phyllite and sandstone in the upper part. The conformably underlying Precambrian sedimentary formations are not exposed in the GRA, nor is crystalline basement rock.

Conformably overlying the Campito is a series of four Cambrian formations, from bottom to top: the Poleta Formation, more than 1,000 feet of carbonate rocks with some siltstone; the Harkless Formation, 3,500 feet of mostly siltstone; the Mule Spring Limestone a few hundred feet thick; and the Emigrant Formation, consisting of several thousand feet of claystone and limestone.

The youngest Paleozoic rock in the GRA is the Ordovician Palmetto Formation of several thousand feet of cherty shale, conformably overlying the Emigrant Formation.

Intruded into the Paleozoic rocks are bodies of generally coarse-grained quartz monzonite, with some granodiorite, and small bodies of felsite, andesite and pegmatite, all of Triassic/Jurassic age. Mineralization related to these intrusions is known at several places in the region, including the Mineral Ridge district, part of which is in the northeast corner of the GRA, and the Dyer district in the western part of the GRA.

In Miocene and Pliocene times sediments were deposited in large basins, generally with conglomerates at the base and clastic lakebeds above. Many of these units were formerly lumped together as the Esmeralda Formation, but more recent work demonstrates that different basins served as the depositional sites at different times and the name has been largely abandoned.

In the Pliocene a volcanic vent area was formed in the middle of the present Silver Peak Range, from which an estimated 25 cubic miles of lavas, tuffs and breccias were extruded (Robinson, 1972). These rocks form the bulk of the Silver Peak Range and cover most of the GRA and WSA NV 050-0388. They can conveniently be grouped into three major divisions on the basis of age and composition.

The oldest volcanics are rhyolite domes, flows, and tuffs, dated at about six million years. Very soon after their deposition a series of latite flows and tuffs was erupted,

which are also dated as about six million years old. The thickness of individual flows or tuffs varies greatly over short distances, but the aggregate thickness of the rhyolites and latites together is probably a few thousand feet in the center of the range and diminishes to less than a thousand feet -- or none at all -- at the edges of the range. Finally, overlying all of the older volcanics, are some thin basalt flows that in places are interbedded with sediments that were deposited in local basins.

3. STRUCTURAL GEOLOGY AND TECTONICS

The Paleozoic rocks are moderately folded, with the axes of the folds trending northwest. Many of the Triassic/Jurassic intrusions, both minor ones and large ones, are elongated in this direction. Many pre-Tertiary strike-slip faults also strike northwest, but east-striking faults also are common, and thrust faulting is widespread (Albers and Stewart, 1972).

The earliest structure recognized in the Tertiary is a northwest-trending trough connecting the present Fish Lake and Clayton valleys. It extended through the middle of the present Silver Peak Range and the GRA in Middle to Late Pliocene, and provided the depression in which some of the youngest "Esmeralda Formation" sediments were deposited (Robinson and others, 1968).

The dominant structural feature in the Silver Peak Range and the GRA is the Silver Peak caldera, formed by the collapse of the roof of the magma chamber after the large volume of rhyolitic flows and tuffs were extruded. The caldera is about four miles wide and eight miles long, its long axis trending northwesterly. The latite flows and tuffs were extruded from several points around the rim of the caldera, filling the depression of the caldera itself and flowing outward for limited distances (Robinson, 1972).

Some of the more extensive flows have overall dips outward from the center of the range that may be in part initial dips. Other units, to the extent that layering is discernable, have widely varying dips that probably are largely due to local pre-deposition topography or later minor readjustments. Baker (1982) distinguishes northeast-trending broad warps in the youngest of the Tertiary sediments.

There are numerous northeast-striking faults in the Tertiary rocks, most of them dipping to the northwest. Some have displacements of more than 1,000 feet, but most have less than 500 feet of displacement. All of the veins in the Red Mountain mining district, which is in the eastern part of the GRA, are in northeast-striking structures.

4. PALEONTOLOGY

The Silver Peak GRA contains the type section of the Miocene Esmeralda Formation (as originally defined by Turner, 1900) which contains abundant fossil non-marine mollusks, mammals, plants, insects, and fish, although not all occur at Silver Peak itself. Firby (1966, 1969) has described a molluscan fauna of 34 species from Stewart Valley in beds assigned to the Esmeralda formation, and Turner (1900), Buwalda (1914) have noted both plant, vertebrate, and molluscan faunas from within the area of the GRA. All units designated by Stewart (1980) as his map unit T 3 are assignable to the original concept of the Esmeralda Formation and are, locally, abundantly fossiliferous. For faunal lists of mollusks the reader is referred to Firby (1966); for mammals to Buwalda (1914), Mawby (1965); and for plants to Wolfe (1964).

Other lithologies within the Silver Peak GRA are devoid of fossils.

5. HISTORICAL GEOLOGY

After a long period of deposition of marine sediments during the Early Paleozoic, the resulting rocks were folded. Later during the Triassic/Jurassic, granitic intrusive bodies were emplaced along zones of weakness parallel to the fold axes, and solutions emanating from the intrusives formed some ore deposits. A long period of erosion, lasting until well into the Tertiary followed this orogeny.

Starting in Miocene and lasting until mid-Pliocene, subaerial and lakebed sediments were deposited in large basins, some of which were at least partly coextensive with present-day valleys, but some were not. Late in this period, sediments were deposited in a trough through what is presently the Silver Peak mountains. Whether this trough was erosional or structural is not known, but it is noteworthy that its axis paralleled the axes of the much earlier folding of the Paleozoic rocks and of major igneous bodies intruded into them.

In Late Pliocene time a volcanic center developed near the middle of the mid-Pliocene trough, and eruptions from it built most of the present-day Silver Peak Range. After the eruption of voluminous rhyolite flows and tuffs, the roof of the magma chamber collapsed to form the Silver Peak caldera, the long axis of which, like earlier structures, trends northwest. Andesitic eruptions filled the caldera and built the overall range higher. According to one interpretation (Baker, 1982), resurgent movement in the magma chamber domed the caldera to produce broad warping, and then the chamber collapsed again, this time along the series of northeast-striking faults that transects the range. The last gasp of volcanism was the production of hydrothermal solutions that formed precious-

metal veins in some of the northeast-striking faults both within the caldera and to the east of it. The resulting Red Mountain district, which is known to be about one and one-half miles wide and four miles long, trends northwesterly like earlier geological features.

III. ENERGY AND MINERAL RESOURCES

A. METALLIC MINERAL RESOURCES

1. Known Mineral Deposits

All known metallic mineral deposits in the GRA are in one or another of the three mining districts (see Metallic Mineral Occurrences and Land Classification Map). Technically, the Mineral Ridge district and the Red Mountain district are parts of one district -- the Silver Peak district, though geologically and geographically they are separate and different. The Mineral Ridge district is credited with about $13 million production in gold, which was mined in the 1860s and 70s and in the 1930s (Albers and Stewart, 1972) and would be valued at about $200 million in the 1980s. The Red Mountain district produced about $3 million in silver in the late 1930s (about $30 million in the 1980s). The 16-to-1 mine which is now operating there has reserves of 1.1 million tons averaging 0.035 ounces/ton gold and eight ounces/ton silver according to published reports. The west end of the known northwest-trending Red Mountain district is two to five miles from the east edge of WSA NV 050-0388. The Dyer district, on the western edge of the WSA, is credited with $13,000 production, with the values mostly in silver (Albers and Stewart, 1972).

2. Known Prospects, Mineral Occurrences and Mineralized Areas

There are numerous prospects in the GRA but only a few within WSA NV 050-0388. Albers and Stewart (1972, Plate 2) show two prospects near the southwest corner of the WSA, one of them within the WSA boundary. They also show the Dyer district, which has produced some silver, as a cluster of prospects, three of which lie within the WSA boundary.

Extending northwestward from the west end of what might be called the "known" Red Mountain district -- northwestward from the productive Mohawk mine -- is an altered area about two miles wide and five or six miles long, lying along the northern side of the Silver Peak caldera. About in the middle of this area, and in the middle of T 2 S, R 37 E, is a two or three square mile patch in which the rocks are argillized, intensely bleached, and iron-stained. Elsewhere in the area alteration of the rocks is much weaker, but there are numerous northeast-striking erosion resistant altered ribs, with weak associated silicification. Some of these ribs have geochemically anomalous values in precious metals and elements that are considered indicators of precious metal mineralization. Aerial photo study shows that these ribs persist for at

least half a mile into the eastern part of WSA NV 050-0388, in (unsurveyed) Secs. 8 and 18, T 2 S, R 37 E (color photos flown August 21, 1980, BLM 24, NV80BC). The ribs have been interpreted as the uppermost parts of epithermal veins, some hundreds of feet above the potentially ore-bearing zones (Baker, 1982).

Rocks three miles northwest of Piper Peak near the head of Icehouse Canyon, and mapped by Stewart and others (1974) as Cambrian Harkless(?) Formation, have an uncharacteristic pink color on aerial photos (color photos flown August 21, 1980, BLM 24 NV80BC). This exposure is about four miles east of the Dyer district and a mile east of exposures of a Jurassic intrusive body that Albers and Stewart (1972) imply may have been the source of the mineralization of the Dyer district. The area between the intrusive and the Harkless(?) exposures is mostly covered by Tertiary rocks, except for a small patch mapped as intrusive and Cambrian Poleta Formation (?) (Stewart and others, 1974). The coloration of the Harkless, and the fact that Stewart and others could not identify the formations with certainty, suggests that they are altered. The area is within the WSA.

3. Mining Claims

Patented claims in the GRA are all in the Mineral Ridge and Red Mountain districts, well to the east of WSA NV 050-0388.

There are a great many unpatented claims, most of them in the eastern part of the GRA in and around the Mineral Ridge and Red Mountain districts. The altered area northwest of the Red Mountain district has unpatented claims, including about a hundred that Baker, the writer of this section of this report, and others staked and filed after the USBLM compilation used here to make the claim map was made (but before the Request For Proposal for this project was issued). Baker's claims extend to within a mile and a half of the northern tip of the WSA. Other claims in the southern part of the altered area lie close to the boundary of the WSA somewhat to the south of Baker's.

Nothing is known of the claims in two quarter-sections in the northern part of the WSA near the east edge.

In the southeast corner of the WSA there are claims in four quarter-sections.

In the western part of the GRA there is a cluster of claims in the Dyer district. A few of these plot as being within the WSA, and they probably cover some or all of the

prospects that Albers and Stewart (1972) shows here, mentioned above.

Just north of the WSA a couple of dozen sections, some in Fish Lake Valley itself and some in the low hills east of the valley, appear to be completely covered with claims. These presumably were located for borates and will be considered in the section on nonmetallic minerals.

4. Mineral Deposit Types

The deposits at Mineral Ridge are gently dipping lenses of white quartz containing gold (Spurr, 1906), and also steeply-dipping tabular quartz veins (Albers and Stewart, 1972). The nature of the veins and their setting in pre-Tertiary rocks close to an intrusive body indicates that they are mesothermal or possibly hypothermal veins related to the intrusive, which has been dated as Precambrian (Bailly and Compton, 1955) and as early Tertiary (Albers and Stewart, 1972).

The Dyer deposits are reported to be quartz veins with a black copper-silver mineral that is oxidized to copper carbonate and silver chloride, in crushed limestone and shaly limestone of the Poleta Formation (Albers and Stewart, 1972). This description, and the nearby Triassic/Jurassic intrusives, suggests that they also are mesothermal veins related to the old intrusives.

The veins of the Red Mountain district are typically epithermal: banded quartz and calcite, locally with some barite and manganese, vuggy textures, and clearly formed by fissure filling. Since they are in rocks of the Silver Peak volcanic pile which are dated at not more than six million years, they must be considered related to the volcanism.

5. Mineral Economics

All of the metallic mineralization known in the Silver Peak Range GRA has gold and silver as its only appreciable values -- all occuring in veins. Except for a few shallow hand-dug pits, all of it has been mined by underground methods from narrow tabular orebodies. The three mines that have been productive in the Red Mountain district -- the Nivloc, 16-to-1, and Mohawk -- had (have) grades ranging from 20 ounces/ton silver with no gold (Mohawk) down to eight ounces/ton silver with some gold (16-to-1). It appears that a fairly substantial tonnage with at least 10 ounces/ton silver or its dollar equivalent in silver and gold is required to make a profitable mine.

Elsewhere in Nevada (e.g. Round Mountain) large mass-mineable, low-grade gold deposits have been found in volcanic terranes similar to that of the Red Mountain district. It is possible that such deposits may be found in Red Mountain either in shattered massive volcanics, perhaps near the caldera rim, or in permeable tuff beds in or out of the caldera. If they are shallow enough to be mined by open pit, deposits that average only about three ounces/ton silver might well be profitable.

The major use of gold is for storing wealth. It is no longer used for coinage because of monetary problems, but many gold "coins" are struck each year for sale simply as known quantities of gold that the buyer can keep or dispose of relatively easily. The greatest other use of gold is in jewelry, another form of stored wealth. In recent years industrial applications have become increasingly important, especially as a conductor in electronic instrumentation. In the United States and some other countries gold is measured in troy ounces that weigh 31.1 grams -- twelve of which make one troy pound. Annual world production is about 40 million ounces per year, of which the United States produces somewhat more than one million ounces, less than one-fourth of its consumption, while the Republic of South Africa is by far the largest producer at more than 20 million ounces per year. World production is expected to increase through the 1980s. For many years the price was fixed by the United States at $35 per ounce, but after deregulation the price rose to a high of more than $800 per ounce and then dropped to the neighborhood of $400 per ounce. At the end of 1982 the price was $460.50 per ounce.

The major uses of silver are in photographic film, sterlingware, and increasingly in electrical contacts and conductors. It is also widely used for storage of wealth in the form of jewelry, "coins" or bullion. Like gold it is commonly measured in troy ounces, which weigh 31.1 grams, twelve of which make one troy pound. World production is about 350 million ounces per year, of which the United States produces about one-tenth, while it uses more than one-third of world production. About two-thirds of all silver is produced as a byproduct in the mining of other metals, so the supply cannot readily adjust to demand. It is a strategic metal. Demand is expected to increase in the next decades because of growing industrial use. At the end of 1982 the price of silver was $11.70 per ounce.

B. NONMETALLIC MINERAL RESOURCES

1. Known Mineral Deposits

In the late 1800s borate deposits were mined in the marshes of Fish Lake Valley in and just north of the GRA, and in 1939 borates were produced from deposits in the hills east of the earlier mines (Albers and Stewart, 1972).

No other nonmetallic mineral deposits are known in or close to the GRA.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

There are no known nonmetallic mineral prospects, occurrences or mineralized areas in or close to the GRA.

3. Mining Claims, Leases and Material Sites

No mining claims can be identified as having been located for nonmetallic minerals. There are no mineral leases or material sites in the GRA.

4. Mineral Deposit Types

Borates produced from Fish Lake Valley occurred as the mineral ulexite, also known as cottonball, in thin layers a few inches below the surface. Borates from the hills east of the valley floor also were ulexite, occurring as veinlets and cottonball aggregates in Pliocene/Pleistocene lake beds. The lake beds extend southward alongside the WSA, but not within it. The adjacent rocks within the WSA are older than the borate-bearing sediments (Robinson and others, 1976) so there is no possibility that the sediments extend into the WSA under cover of younger rocks.

5. Mineral Economics

Ulexite occurrences of boron were mined extensively in the 1800s, but after much larger bodies of much higher grade borate minerals were discovered, ulexite mining was abandoned -- it could not compete. The extensive claim coverage of the ulexite-bearing area is probably in hopes of finding better deposits at depth. Some drilling was done at the edge of Fish Lake Valley, in the borate area, in late 1981 (Baker, personal communcation), but this may have been for geothermal resources.

About half of all boron is used in the glass industry, most of it in glass fibers for insulation or textiles but some for specialty glasses such as Pyrex. The remainder is used in a wide variety of products such as glazes, detergents, herbicides, fluxing materials in welding, abrasives, fire retardants, and many others. The United States consumes annually about 125,000 short tons of boron, while producing hearly twice this amount. It is the largest consumer and producer of boron in the world and supplies much of the world market. United States consumption is expected to more than double by the year 2000, with production continuing to be well above consumption. The price of borax pentahydrate, the standard compound in which boron is sold, is about $175 per short ton.

C. ENERGY RESOURCES

Uranium and Thorium Resources

1. Known Mineral Deposits

There are no known uranium or thorium deposits in the WSA or GRA.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

Radioactive occurrences are shown on the Uranium Land Classification and Mineral Occurrence Map included at the back of the report.

There are two known uranium occurrences within the GRA east and northeast of the WSA. At the Mustang Nos. 1-7 claims (Sec. 32, T 1 S, R 37 E) uranium mineralization occurs in Tertiary lacustrine sediments, and at the 16-to-1 claim (S 1/2 Sec. 32, T 2 S, R 38 E) slight radioactivity is reported from a quartz vein cutting altered tuff (Garside, 1973). Several other radioactive occurrences have been noted in areas surrounding the GRA (Garside, 1973). These are tabulated below:

Name	Location	Occurrence
Aching Back, Blue Moon, Rosamunda, Topnotch and Happy Day claims	Sec. 8(?) or 9(?), T 1 N, R 35 E	Slight radioactivity associated with petrified wood in Tertiary sandstone and conglomerate

Magma group (5 claims)	Center, Sec. 33, T 2 N, R 36 E	Radioactivity associated with iron-stained quartz stringers along rhyolite-tuff contact
Name Unknown	SW 1/4 Sec. 4, T 1 N, R 36 E	Slight radioactivity associated with bentonitic conglomerate
Anniversary claim	Sec. 2 or 3, T 1 N, R 36 E	Slight radioactivity associated with folded and brecciated Ordovician limestone and shale
Gap Strike group, Sammy group, Wolf group	Secs. 3 and 10(?), T 1 N, R 36 E	Autunite and carnotite in lacustrine tuffs and ferruginous sandstone
Coaldale Prospect, Phillips and Wentland No. 1 claims, Quinseck claim	Center Sec. 33, T 2 N, R 37 E	Uranium mineralization in siliceous veinlets, breccia pipe, limonite stained joints and cavity fillings in rhyolitic tuffs.
Jet group (nos. 1-25), Taylor claims, Utron group (4 claims)	Sec. 23, T 1 N, R 39 E	Anomalous radioactivity associated with iron stained fractures in Tertiary tuffs and rhyolites

Weepah Uranium group (14 claims)	Secs 20, 21, T 1 N, R 40 E	Anomalous radioactivity along fault in meta-sediments
Virginia Group (17 claims)	SE 1/4 Sec. 15, T 2 S, R 39 E	Radioactive hot springs
Esmeralda Uranium No. 28, Esmeralda No. 15, Uno No. 6, Buckeye No. 1, Eds No. 5, M and R No. 6, Minnie No. 50 claims	SW 1/4, Sec. 25 and NW 1/4 Sec. 36, T 4 S, R 38 E	Autunite associated with seams up to 6" thick in interbedded tuffaceous and sandy lacustrine beds

3. Mining Claims, Leases and Material Sites

The only known uranium or thorium claims or leases within or near the GRA are those described above, and these have probably lapsed.

4. Mineral Deposit Types

Deposit types cannot be discussed due to the lack of uranium or thorium deposits in the GRA.

5. Mineral Economics

Uranium and thorium appear to be of no economic value in the GRA due to the lack of deposits of these elements.

Uranium in its enriched form is used primarily as fuel for nuclear reactors, with lesser amounts being used in the manufacture of atomic weapons and materials which are used for medical radiation treatments. Annual western world production of uranium concentrates totaled approximately 57,000 tons in 1981, and the United States was responsible for aout 30 percent of this total, making the United States the largest single producer of uranium (American Bureau of Metal Statistics, 1982). The United States ranks second behind Australia in uranium resources based on a production cost of $25/pound or less. United States uranium demand is growing at a much slower rate than was forecast in the late 1970s, because the number of new reactors scheduled for construction has declined sharply since the accident at the Three Mile Island Nuclear Plant in March, 1979. Current and future supplies were seen to exceed future demand by a significant margin and spot prices of uranium fell from $40/pound to $25/pound from

January, 1980 to January, 1981 (Mining Journal, July 24, 1981). At present the outlook for the United States uranium industry is bleak. Low prices and overproduction in the industry have resulted in the closures of numerous uranium mines and mills and reduced production at properties which have remained in operation. The price of uranium at the end of 1982 was $19.75/pound of concentrate.

Thorium is used in the manufacture of incandescent gas mantles, welding rods, refractories, as fuel for nuclear power reactors and as an alloying agent. The principal source of thorium is monazite which is recovered as a by-product of titanium, zirconium and rare earth recovery from beach sands. Although monazite is produced from Florida beach sands, thorium products are not produced from monazite in the United States. Consequently, thorium products used in the United States come from imports, primarily from France and Canada, and industry and government stocks. Estimated United States consumption of thorium in 1980 was 33 tons, most of which was used in incandescent lamp mantles and refractories (Kirk, 1980b). Use of thorium as nuclear fuel is relatively small at present, because only two commercial thorium-fueled reactors are in operation. Annual United States demand for thorium is projected at 155 tons by 2000 (Kirk, 1980a). Most of this growth is forecast to occur in nuclear power reactor usage, assuming that six to ten thorium-fueled reactors are on line by that time. The United States and the rest of the world are in a favorable position with regard to adequacy of thorium reserves. The United States has reserves estimated at 218,000 tons of ThO_2 in stream and beach placers, veins and carbonatite deposits (Kirk, 1982); and probable cumulative demand in the United States as of 2000 is estimated at only 1,800 tons (Kirk, 1980b). The price of thorium oxide at the end of 1981 was $16.45 per pound.

Oil and Gas Resources

There are no known oil and gas deposits or oil seeps in the GRA or bordering areas, but four exploratory wells were drilled -- two in the GRA. These two wells, the California Excelsior Oil Co. McNett Ranch No. 1 (Locality #1 on the Oil and Gas Occurrence and Land Classification Map) drilled to 488 feet in 1920, and was offset by the Fish Lake Merger Oil Co. No. 1 (also #1) which drilled to 1,447 feet in 1920 (Lintz, 1957).

Four miles northwest of the GRA in Big Smoky Valley, a local group drilled the Wright Exploration Co. Federal 26-1 (#2) to 5,666 feet in 1978 (Nevada Bureau of Mines and Geology, 1982).

A mile outside the GRA, Nevada Oil and Minerals drilled the V.R.S. No. 1 (#3), 4,776-foot test in 1970. There were no oil or gas shows in any of the four wells (Garside and others, 1977; Nevada Bureau of Mines and Geology, 1982).

There are two sections under lease for oil and gas in the WSA in the mountains above the Circle L Ranch in Fish Lake Valley, another section at the Nevada Oil and Minerals well site, and a larger number of leases near the town of Silver Peak in Clayton Valley. Although there is leasing and past drilling, the section beneath the WSA is not considered prospective due to the absence of potential source beds.

Oil deposits being developed and explored for in Nevada are anticipated to be structural and/or stratigraphic trap-type within the Paleozoic or Tertiary sedimentary or volcanic strata. It is currently economical to truck production from the existing oil fields in remote Railroad Valley to Nevada or out-of-state refineries.

Geothermal Resources

1. Known Geothermal Deposits

   There is a large area in Fish Lake Valley where shallow water wells and springs (Locality #1 on the Geothermal Occurrence and Land Classification Map) have encountered water of 73° to 81°F. Half of this thermal area is in the GRA. A second area, six miles east of the GRA, is the Silver Peak Hot Springs (#2) with water of 69° to 118°F (Garside and Schilling, 1979).

2. Known Prospects, Geothermal Occurrences, and Geothermal Areas

   Several known prospects and occurrences are located not far outside the GRA. Amax has drilled numerous shallow- and intermediate-depth drill holes in localities #3, #4 and #5. Nothing is known about the two former localities, but the continuing drilling effort (holes up to 2,045 feet in depth) at #5 indicates this is a very prospective area. Amax is exploring for a resource of approximately 400°F or higher. A water well (#6) with water of 71°F is located in Big Smoky Valley (Garside and Schilling, 1979; Nevada Bureau of Mines and Geology, 1982).

   The Nevada Oil and Minerals Inc. V.R.S. No. 1 (#7), an oil test well drilled in 1970 to 9,178 feet, reportedly encountered a 313°F temperature (Nevada Bureau of Mines and Geology Oil and Gas Files, 1982).

3. Geothermal Leases

Sizeable leasehold positions are present in northern Fish Lake Valley, the eastern Silver Peak Range, northwestern Clayton Valley and in southern Big Smoky Valley. Thirty-six sections are under lease in the GRA, though none are in the WSA.

4. Geothermal Deposit Types

Geothermal resources are hot water and/or steam deposits which occur in subsurface reservoirs or at the surface as springs. The temperature of a resource may be about 70°F (or just above average ambient air temperature) to well above 400°F in the Basin and Range province.

The reservoirs may be individual faults, intricate fault-fracture systems, or rock units having intergranular permeability -- or a combination of these. Deep-seated normal faults are believed to be the main conduits for the thermal waters rising from thousands of feet below in the earth's crust.

The higher temperature and larger capacity resources in the Basin and Range are generally hydrothermal convective systems. The lower temperature reservoirs may be individual faults bearing thermal water or lower pressured, permeable rock units fed by faults, or fault systems. Reservoirs are present from the surface to over 10,000 feet in depth.

5. Geothermal Economics

Geothermal resources are utilized in the form of hot water or steam normally captured by means of drilling wells to a depth of a few feet to over 10,000 feet in depth. The fluid temperature, sustained flow rate and water chemistry characteristics of a geothermal reservoir, as well as the end use, determine the depth to which it will be economically feasible to drill and develop each site.

Higher temperature resources (above 350°F) are currently being used to generate electrical power in Utah and California, and in a number of foreign countries. As fuel costs rise and technology improves, the lower temperature limit for power will decrease appreciably -- especially for remote sites.

All thermal waters can be beneficially used in some way, including fish farming (68°F), warm water for year around mining in cold climates (86°F), residential space heating (122°F), greenhouses by space heating (176°F), drying of vegetables (212°F), extraction of salts by evaporation and

crystallization (266°F), and drying of diatomaceous earth (338°F). These are only a few examples.

Unlike most mineral commodities remoteness of resource location is not a drawback. Domestic and commercial use of natural thermal springs and shallow wells in the Basin and Range province is a historical fact for over 100 years.

Development and maintenance of a resource for beneficial use may mean expenditure of no dollars or hundreds of millions of dollars, depending on the resource characteristics, the end use and the intensity or level of use.

D. OTHER GEOLOGICAL RESOURCES

No other geological resources are known in WSA NV 050-0388. Although small amounts of poor coal were produced from deposits at Coaldale, a few miles north of the GRA, there is no evidence or reasoning to indicate that coal, oil shale or tar sands might be present in the GRA.

E. STRATEGIC AND CRITICAL MINERALS AND METALS

A list of strategic and critical minerals and metals provided by BLM was used as a guideline for the discussion of strategic and critical materials in this report.

The Stockpile Report to the Congress, October 1981-March 1982, states that the term "strategic and critical materials" refers to materials that would be needed to supply the industrial, military and essential civilian needs of the United States during a national emergency and are not found or produced in the United States in sufficient quantities to meet such need. The report does not define a distinction between strategic and critical minerals.

Silver, a strategic metal, has been produced in large quantities from the GRA.

IV. LAND CLASSIFICATION FOR G-E-M RESOURCES POTENTIAL

The maps at 1:62,500 scale of Robinson and others (1976), Stewart and others (1974), Krauskopf (1971), and Robinson and Crowder (1973), and other publications provide excellent geological coverage of the entire GRA. Prospect descriptions in Albers and Stewart (1972) and in other publications are good and Arthur Baker III, one of the writers of this report, has examined virtually all mines and prospects in and near the Red Mountain district. The quantity and quality of geological data available are both excellent. The quantity and quality of data pertaining to mineralization are high. The overall level of confidence in the data available is high.

Land classification areas are numbered starting with the number 1 in each category of resources. Metallic mineral land classification areas have the prefix M, e.g., M1-4D. Uranium and thorium areas have the prefix U. Nonmetallic mineral areas have the prefix N. Oil and gas areas have the prefix OG. Geothermal areas have the prefix G. Sodium and potassium areas have the prefix S. The saleable resources are classified under the nonmetallic mineral resource section. Both the Classification Scheme, numbers 1 through 4, and the Level of Confidence Scheme, letters A, B, C, and D, as supplied by the BLM are included as attachments to this report. These schemes were used as strict guidelines in developing the mineral classification areas used in this report.

Land classifications have been made here only for the areas that encompass segments of the WSA. Where data outside a WSA has been used in establishing a classification area within a WSA, then at least a part of the surrounding area may also be included for clarification. The classified areas are shown on the 1:250,000 mylars or the prints of those that accompany each copy of this report.

In connection with nonmetallic mineral classification, it should be noted that in all instances areas mapped as alluvium are classified as having moderate favorability for sand and gravel, with moderate confidence, since alluvium is by definition sand and gravel. All areas mapped as principally limestone or dolomite have a similar classification since these rocks are usable for cement or lime production. All areas mapped as other rock, if they do not have specific reason for a different classification, are classified as having a low favorability, with low confidence, for nonmetallic mineral potential, since any mineral material can at least be used in construction applications.

1. LOCATABLE RESOURCES

a. Metallic Minerals

WSA NV 050-0338

M1-3B. This classification area is an elongate area extending from the western edge of the WSA to about its center. At the west end is the Dyer district, mostly outside the WSA but with some prospects within it, which has produced some silver and base metals. Near the east end is the area of apparently altered Paleozoic sediments at the head of Icehouse Canyon. Between are exposures of Jurassic intrusive rocks and a small patch of possibly altered Paleozoic sediments. Elsewhere in the classification area Tertiary rocks cover the older rocks. The areal distribution of the exposures of intrusive rocks, the Dyer district, and the possible altered sediments, suggest that the intrusive body may trend northwestward as do others in the area, and that it has altered the sediments that it is intruded into. The apparent presence of alteration leads to the further deduction that there may be mineralization as well -- most likely base metals or tungsten which are most common in the region in association with Jurassic intrusives. The nearly-complete cover of younger Tertiary rocks could screen the mineralization. This is the line of reasoning that leads to the classification of moderate favorability for metallic mineralization and a low level of confidence.

M2-2B. This classification area covers much of the eastern part of the WSA. It includes the inferred western extension of the Red Mountain district, and is expanded farther west and south to include also the entire Silver Peak caldera and adjacent rocks for about a mile around it. Young calderas such as the Silver Peak caldera are considered to be the sources of mineralization in many epithermal districts, and the presence of this caldera alone suggests favorability for gold-silver mineralization nearby. The alteration noted in the middle and northern part of the classification area provides indirect evidence of mineralization. These are the reasons for the classification of low favorability and low confidence level in the classification.

M3-2A. This classification area covers all of the WSA that is not included in one of the above classification areas. The boundaries of both of the above classification areas were deliberately drawn to limit the areas to within about a mile of the features on which they are based; that is, the exposures of altered Paleozoic sediments in the case of M1-3B and the caldera outline in the case of M2-2B. Mineralization related to either the Jurassic intrusive body or to the caldera could well extend several miles beyond the feature itself. This is the reason for

classifying the remainder of the WSA, and by implication much of the surrounding country, as having low favorability for mineral resources but with very low confidence.

b. Uranium and Thorium

WSA NV 050-0338

U1-2B. This land classification covers almost all of the WSA and most of the central and eastern parts of the GRA. The area has low favorability with a low level of confidence for uranium in caldera-related, fracture filled deposits. The area is covered primarily by Tertiary rhyolitic tuffs and lavas which were emplaced during development of the Silver Peak caldera. Numerous northeast-trending faults may be locations for accumulation of uranium which has been leached from the tuffs and rhyolite flows by ground water or meteoric water. Several minor occurrences of this type in or near the GRA are mentioned above. Fracture-filled deposits are also possible in fractured Paleozoic sediments marginal to the caldera system.

The area has low favorability with a low level of confidence for thorium deposits in Mesozoic granitic intrusions and associated pegmatites which cover small areas of the western part of the WSA and the southern part of the GRA.

U2-2B. This land classification covers the western margin of the GRA, a small area in the east-central part of the GRA and small areas of the WSA. These areas are covered by Tertiary tuffaceous sedimentary rocks and Quaternary alluvium, and they have low favorability with a low level of confidence for epigenetic sandstone-type uranium deposits. Uranium leached from caldera related tuffs and rhyolites by ground water may have been deposited in adjacent tuffaceous sediments or Quaternary alluvium. One example of this type of occurrence has been noted just north of the WSA, and several others have been noted in areas surrounding the GRA, as described above.

Most of the area has very low favorability with very low confidence level for thorium. However, small areas of alluvium along the west and southwest margins of the GRA, adjacent to Mesozoic granite-pegmatite outcrops, could have low favorability for thorium-bearing monazite placer deposits.

c. Nonmetallic Minerals

WSA NV 050-0338

N1-2B. This classification area covers the entire WSA. No nonmetallic mineral occurrences are known in the WSA, but any mineral material may become an economically mineable nonmetallic mineral if someone can develop a market that calls for the particular chemical or physical characteristics of the material. This is the reason for the classification of low favorability with low confidence.

2. LEASABLE RESOURCES

a. Oil and Gas

WSA NV 050-0338

OG1-1D. The WSA is entirely underlain by a complexly distorted section, ranging from metasediments of Ordovician age intruded by Tertiary/Jurassic granitic rocks to Tertiary volcanics. There are no source beds present within the WSA, nor are there favorable structural conditions present for the entrapment of hydrocarbons.

b. Geothermal

WSA NV 050-0338

G1-3B. The leasing positions in the area are indicators of the assumed favorability of high-temperature geothermal resources in both mountain and valley areas, since nearly all leases are filed with electrical power generation as the goal.

Quaternary basalts throughout the GRA and WSA are positive indicators for a Late Cenozoic heat source at depth.

The shallow thermal water wells in locality #1 are right next to the WSA.

All these indications of the presence of low- to high-temperature resources give the WSA at least a moderate favorability rating.

c. Sodium and Potassium

WSA NV 050-0338

S1-1D. This classification area embraces the entire WSA. There is no evidence of sodium or potassium resources, and the geology is such that none is to be expected. This is the reason for the classification of very low favorability and the high level of confidence in the classification. No map is presented for sodium and potassium occurrences and classification.

3. SALEABLE RESOURCES

Saleable resources have been considered in connection with nonmetallic mineral resources.

V. RECOMMENDATIONS FOR ADDITIONAL WORK

1. The Dyer district at the west edge of WSA NV 050-0388 should be examined to determine if mineralization and/or alteration extend into the WSA.

2. The possibly altered exposures of Harkless(?) Formation, four miles east of the Dyer district near the head of Icehouse Canyon in the WSA, should be examined to determine if the rocks are indeed altered, and if so, at least some geochemical sampling should be done.

3. The resistant ribs in the northeast part of the WSA, the westward continuation of alteration staked by Baker, should be examined and sampled to determine if they, too, have anomalous metal values.

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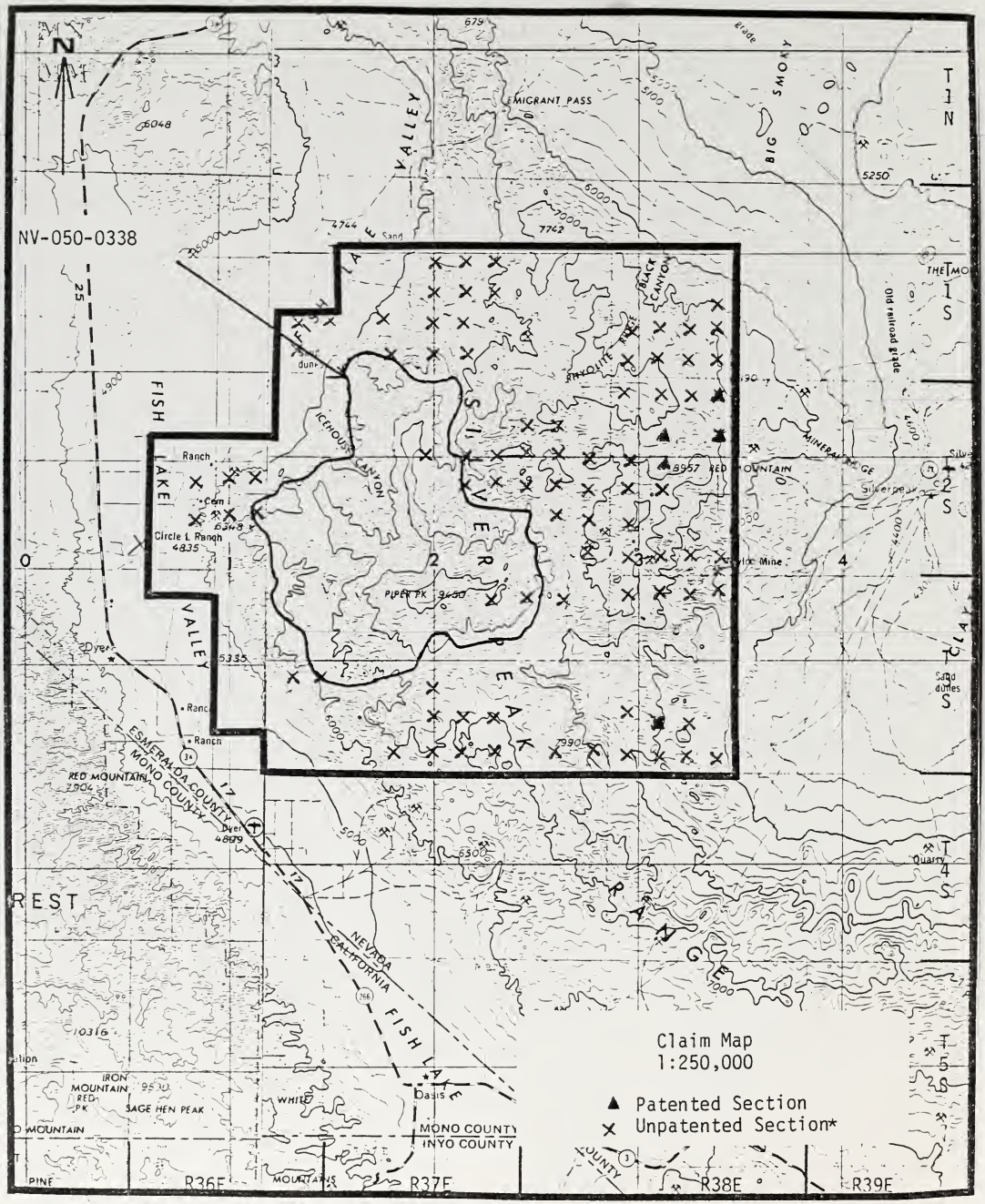
NV-050-0338
Claim Map
1:250,000
▲ Patented Section
× Unpatented Section*
*X denotes one or more claims per section
Silver Peak Range North GRA NV-19
SILVER PEAK RANGE
FISH LAKE VALLEY
ESMERALDA COUNTY
MONO COUNTY
INYO COUNTY
NEVADA
CALIFORNIA
MIGRANT PASS
BIG SMOKY
ICEHOUSE CANYON
BLACK CANYON
PIPER PK 9430
RED MOUNTAIN 7904
IRON MOUNTAIN 9530
SAGE HEN PEAK
WHITE MOUNTAINS
Circle L Ranch 4835
Dyer 4809
Silver Peak
Old railroad grade
Sand dunes
Quarry
Dyer
Ranch
Cem
Oasis
FISH LAKE
R36E
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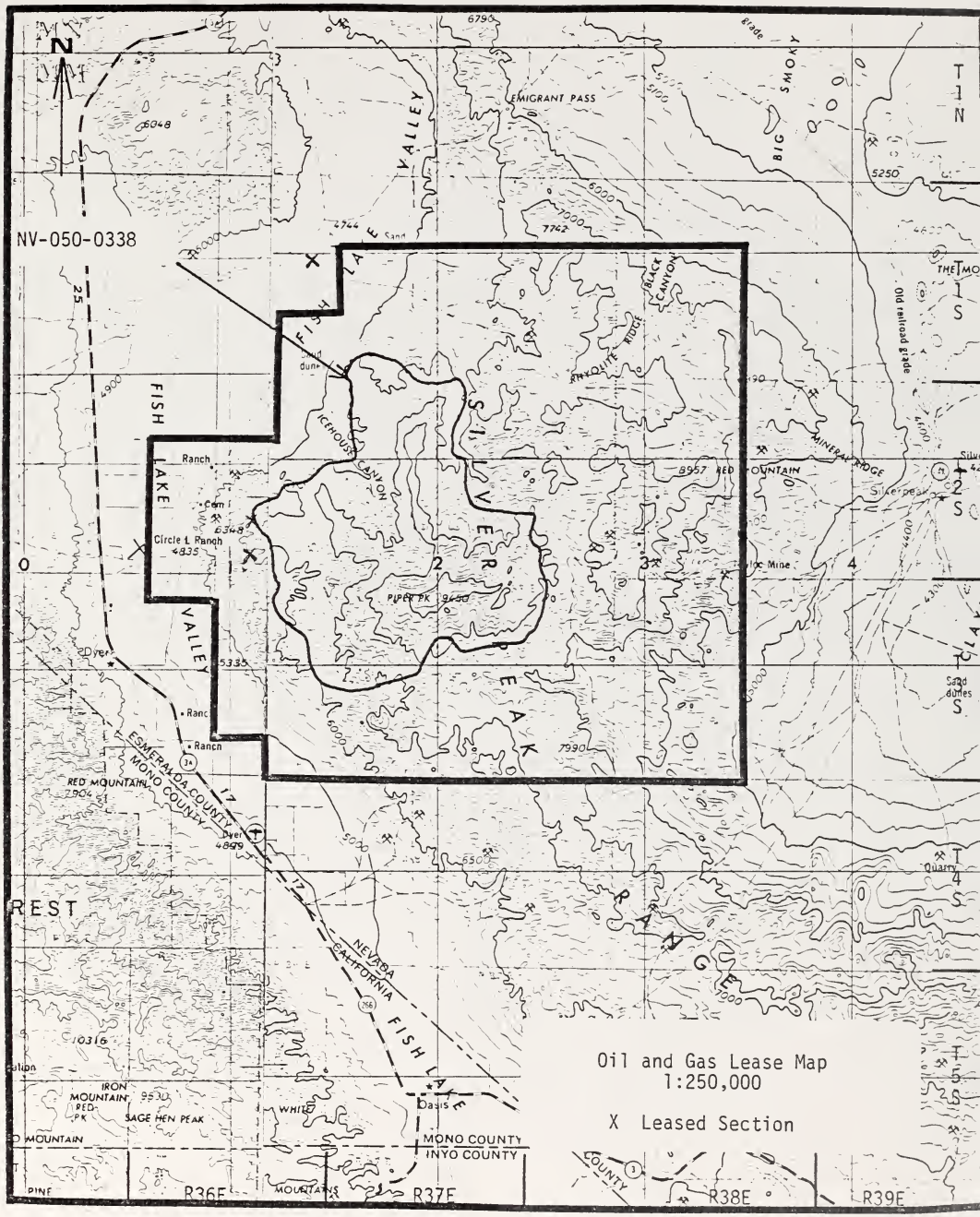
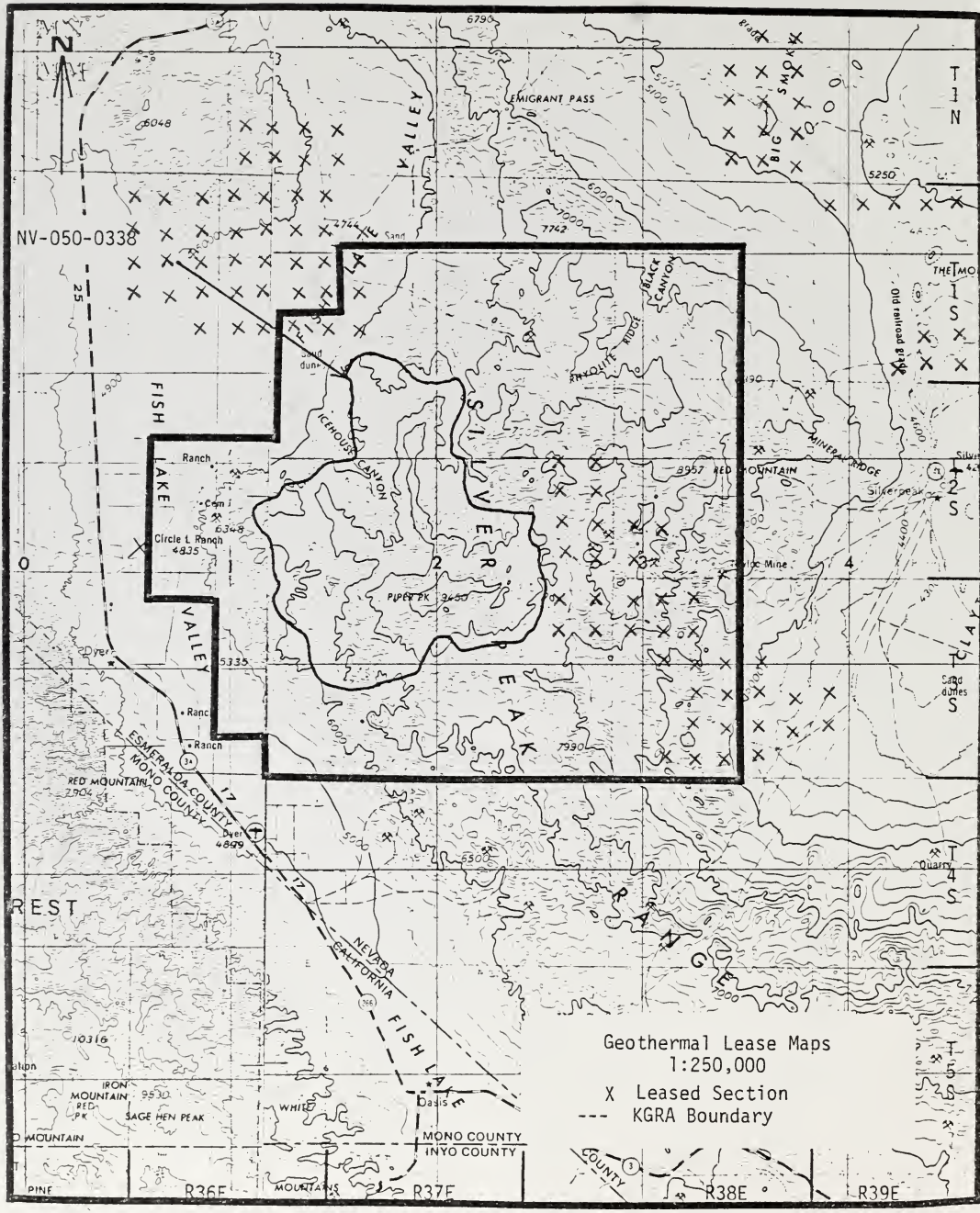


Silver Peak Range North GRA NV-19



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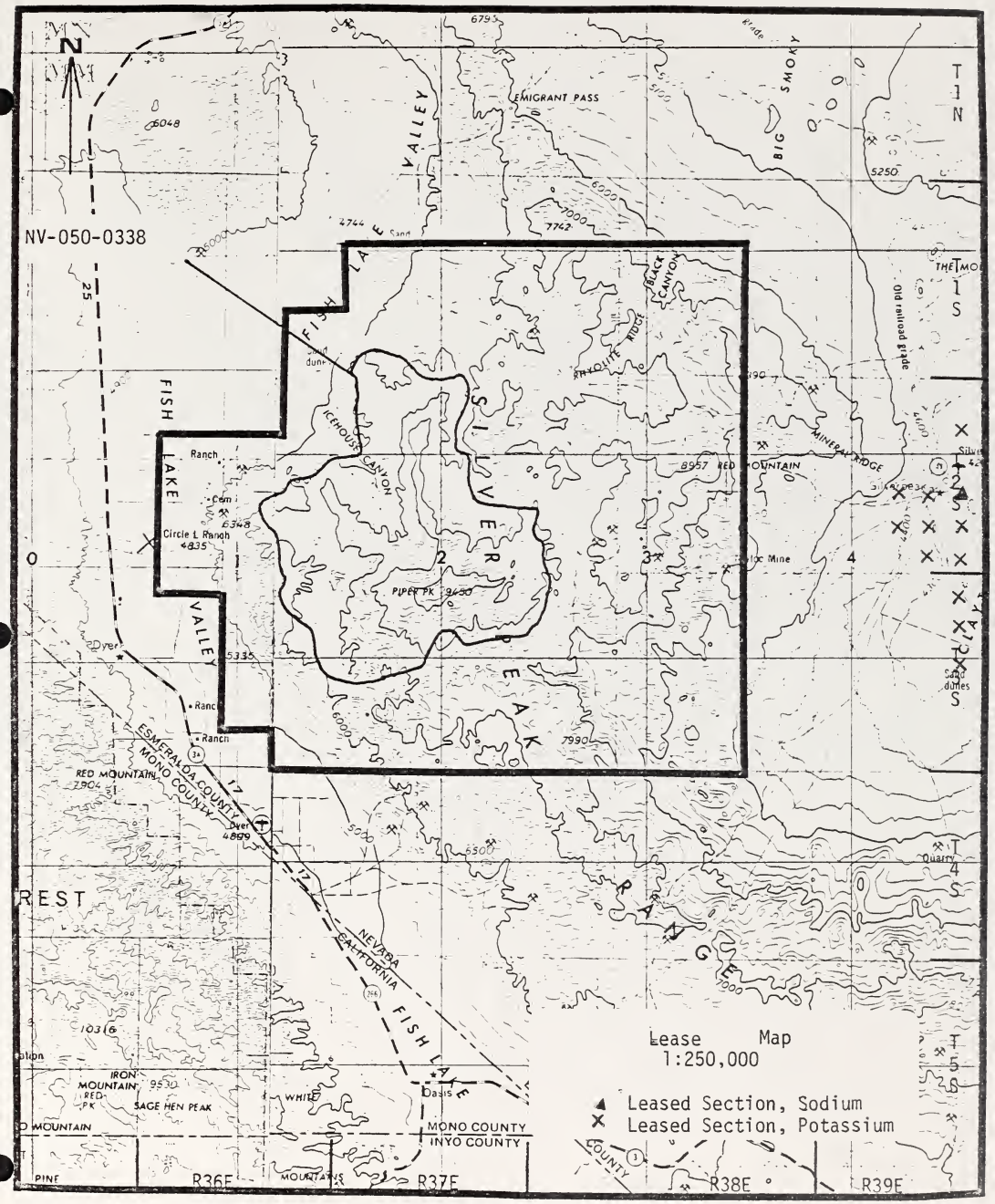

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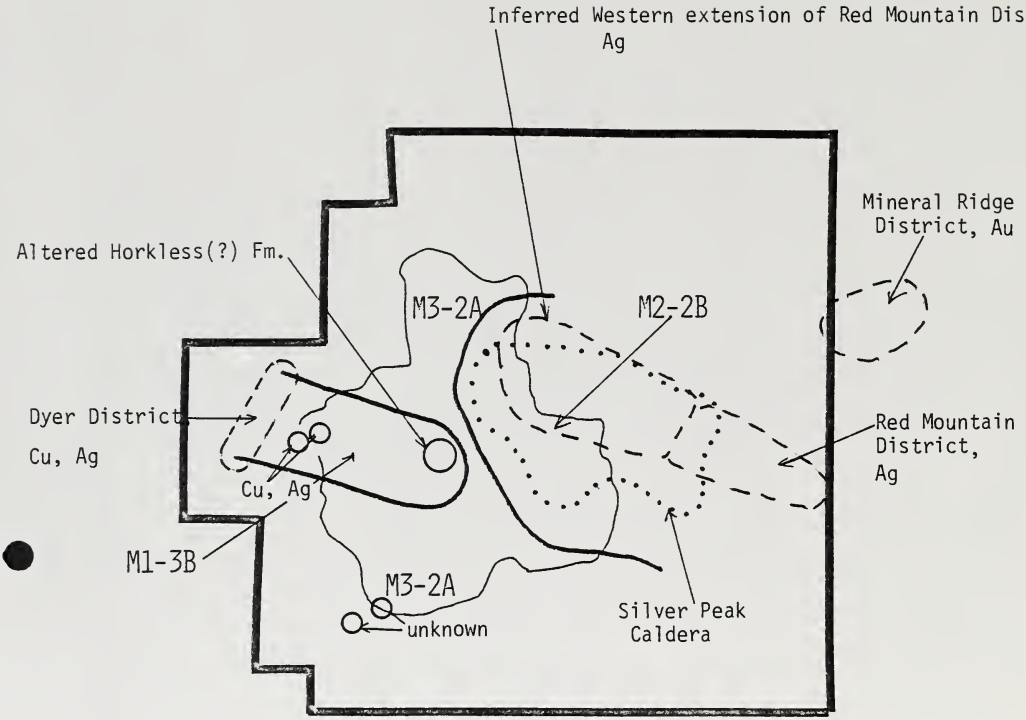


EXPLANATION

- - - Mining District, commodity

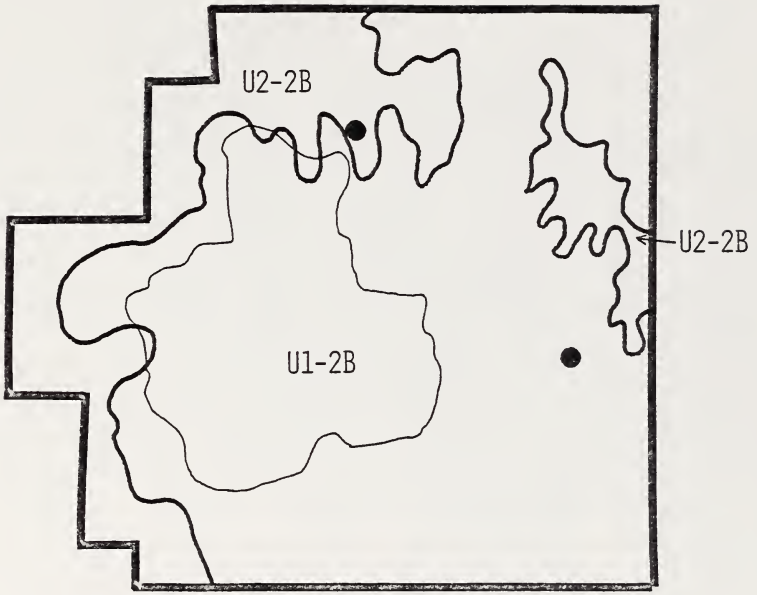
○ Occurrence, commodity

——— Land Classification Boundary

——— WSA Boundary

Land Classification - Mineral Occurrence Map/
Metallics

Silver Peak Range North GRA NV-19
Scale 1:250,000



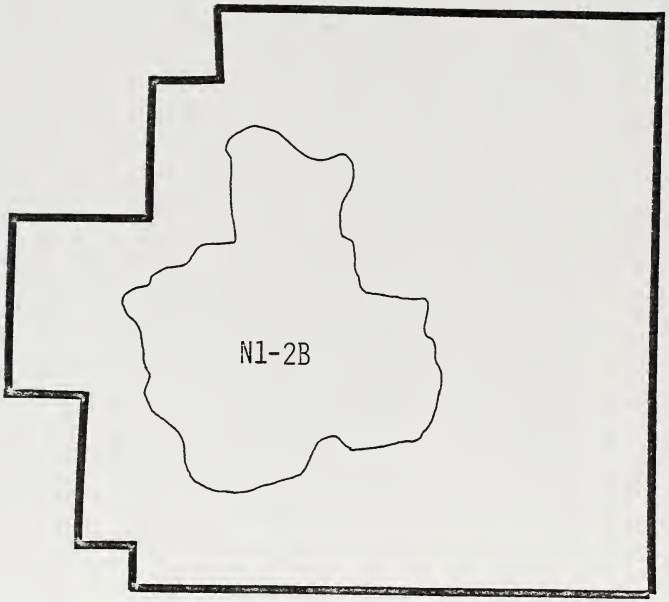
EXPLANATION

- Uranium Occurrence
- Land Classification Boundary
- WSA Boundary

Land Classification - Mineral Occurrence Map/Uranium

Silver Peak Range North GRA NV-19

Scale 1:250,000

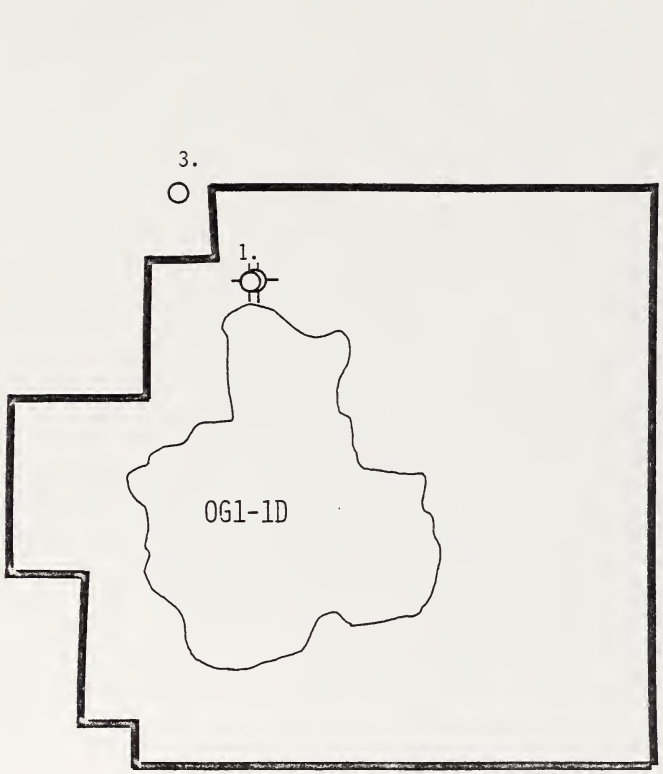


EXPLANATION

—— WSA and Land Classification Boundary

Land Classification - Mineral Occurrence Map/
Nonmetallics

Silver Peak Range North GRA NV-19
Scale 1:250,000



EXPLANATION

Dry hole

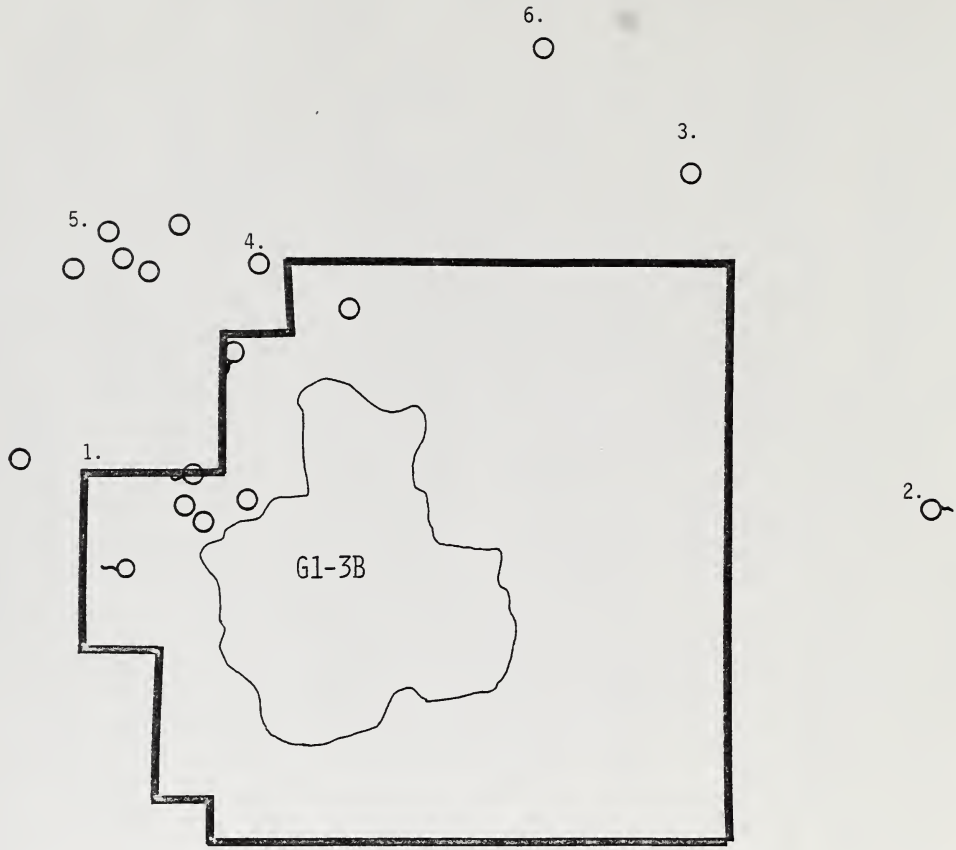
1. Reference location (see text)

WSA and Land Classification Boundary

Land Classification - Mineral Occurrence Map/Oil and Gas

Silver Peak Range North GRA NV-19

Scale 1:250,000



EXPLANATION

- Thermal Well
- Thermal Spring
- 1. Reference location (see text)
- WSA and Land Classification Boundary

Land Classification - Mineral Occurrence Map/Geothermal

Silver Peak Range North GRA NV-19

Scale 1:250,000

LEVEL OF CONFIDENCE SCHEME

A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVELY MINIMAL TO SUPPORT TO REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

MAJOR STRATIGRAPHIC AND TIME DIVISIONS IN USE BY THE U.S. GEOLOGICAL SURVEY

Erathem or Era	System or Period	Series or Epoch	Estimated ages of time boundaries in millions of years
Cenozoic	Quaternary	Holocene	
		Pleistocene	2-3 [1]
	Tertiary	Pliocene	12 [1]
		Miocene	26 [2]
		Oligocene	37-38
		Eocene	53-54
		Paleocene	65
Mesozoic	Cretaceous [4]	Upper (Late) Lower (Early)	136
	Jurassic	Upper (Late) Middle (Middle) Lower (Early)	190-195
	Triassic	Upper (Late) Middle (Middle) Lower (Early)	225
Paleozoic	Permian [4]	Upper (Late) Lower (Early)	280
	Carboniferous Systems: Pennsylvanian [4]	Upper (Late) Middle (Middle) Lower (Early)	
	Carboniferous Systems: Mississippian [4]	Upper (Late) Lower (Early)	345
	Devonian	Upper (Late) Middle (Middle) Lower (Early)	395
	Silurian [4]	Upper (Late) Middle (Middle) Lower (Early)	430-440
	Ordovician [4]	Upper (Late) Middle (Middle) Lower (Early)	500
	Cambrian [4]	Upper (Late) Middle (Middle) Lower (Early)	570
Precambrian [3]		Informal subdivisions such as upper, middle, and lower, or upper and lower, or younger and older may be used locally.	3,600+ [5]

[1] Holmes, Arthur, 1965, Principles of physical geology: 2d ed., New York, Ronald Press, p. 360-361, for the Pleistocene and Pliocene; and Obradovich, J. D., 1965, Age of marine Pleistocene of California: Am. Assoc. Petroleum Geologists, v. 49, no. 7, p. 1087, for the Pleistocene of southern California.

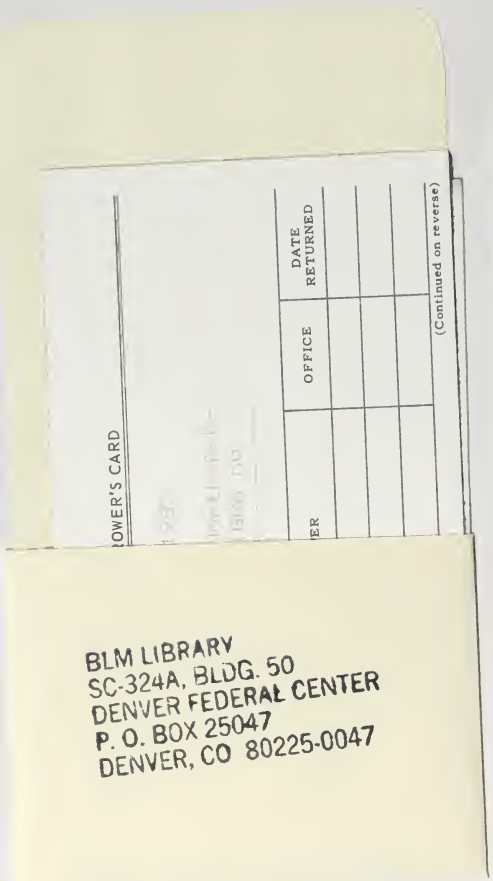
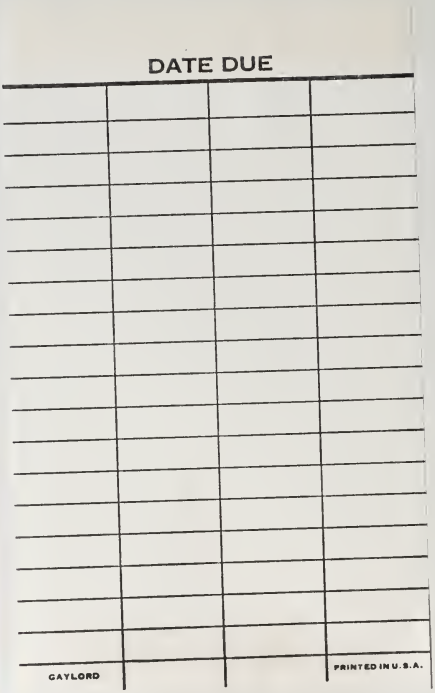
[2] Geological Society of London, 1964, The Phanerozoic time-scale; a symposium: Geol. Soc. London, Quart. Jour., v. 120, suppl., p. 260-262, for the Miocene through the Cambrian.

[3] Stern, T. W., written commun., 1968, for the Precambrian.

[4] Includes provincial series accepted for use in U.S. Geological Survey reports.

Terms designating time are in parentheses. Informal time terms early, middle, and late may be used for the eras, and for periods where there is no formal subdivision into Early, Middle, and Late, and for epochs. Informal rock terms lower, middle, and upper may be used where there is no formal subdivision of a system or of a series.

GEOLOGIC NAMES COMMITTEE, 1970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